HAMPTON ROADS TRANSIT

U.S. Department of Transportation
Federal Transit Administration

Draft Environmental Impact Statement

VIRGINIA BEACH TRANSIT EXTENSION STUDY

Appendix J

Traffic Operations Technical Report

February 2015

Cover image: courtesy of the City of Virginia Beach

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1.0 INTRODUCTION

This technical report has been prepared as a supplement document for the Draft Environmental Impact Statement (DEIS) which examines a range of alternatives for extending high capacity fixed guideway transit service from the eastern terminus of The Tide, the City of Norfolk's light rail transit (LRT) system towards the Oceanfront Resort Area in Virginia Beach. The Federal Transit Administration (FTA), as the lead federal agency, and Hampton Roads Transit (HRT), as the project sponsor, have jointly prepared the DEIS and the supporting studies referenced. These studies are known collectively as the Virginia Beach Transit Extension Study (VBTES).

The transportation planning and traffic engineering analysis that was undertaken assesses the potential impacts and mitigation to transportation performance and parking in the VBTES Corridor. The characteristics of the transportation system were examined under various conditions and are defined below:

- **Existing Conditions**: existing conditions of the transportation system in the VBTES Corridor.
- **Future Conditions:** future transportation conditions without the alternative alignments in the VBTES Corridor.
- **Grade Separation:** describes the methodology and analysis results to determine when grade separations should be considered at major road/transit crossings along the VBTES Corridor.
- **Future Build Conditions:** future conditions plus the operating characteristics for each alternative alignment.
- **Supplemental Analyses:** focused engineering assessments to analyze specific impacts in greater detail.
- **Parking:** how the Build Alternatives will affect available parking through acquisition of land that is currently used for parking and through provision of new parking facilities at designated Park & Ride lots.

1.1 Project Background

The VBTES Corridor for the DEIS extends from The Tide's Newtown Station to the Virginia Beach Oceanfront Resort Area. The corridor includes Interstate 264 (I-264), Virginia Beach Boulevard and Laskin Road (US 58 and Business 58), and the former Norfolk Southern Railway (NSRR) right-of-way (ROW). This technical report serves as a supplemental Project Description

The VBTES Corridor **(Figure 1-1)** is located in the City of Virginia Beach's primary east-west transportation corridor. It extends approximately 11 miles from the eastern terminus of The Tide at Newtown Road eastward to the Oceanfront Resort Area. The VBTES Corridor is the commercial spine of the city. Residential neighborhoods and NAS Oceana are the primary land uses north and south of the VBTES Corridor. It consists of mostly auto-oriented, low-density development.

Figure 1-1| VBTES Corridor

Source: HDR Engineering, 2013

The VBTES Corridor boundary, defined as the area within which project impacts may occur, extends approximately 0.5 mile to the north and south of the former NSRR ROW and Laskin Road and to east of Birdneck Road. The VBTES Corridor includes the growing Virginia Beach Town Center, the Virginia Beach Convention Center, Oceanfront Resort Area hotels and tourist attractions, and many of the City's prominent historical sites; medical, higher education, and other cultural institutions; and residential areas. It also includes six of Virginia Beach's eight Strategic Growth Areas (SGAs) - areas designated by the City for high-density, mixed use, transit-oriented development in support of long-term economic growth. The six SGAs within the VBTES Corridor are located along the City's east-west transportation corridor making them highly supportive of a fixed guideway transit system. The City's largest employer, NAS Oceana, is adjacent to the study area just south of the former NSRR ROW.

The VBTES project involves assessing the environmental impact of transit alignment alternatives and two different transit modes, light rail transit (LRT) and bus rapid transit (BRT), along the former Norfolk-Southern Railroad right-of-way (NSRR ROW) in Virginia Beach and eastward to the Oceanfront at 19th Street. This inactive rail corridor extends from Newtown Road at the Norfolk-Virginia Beach City line eastward to Birdneck Road in a line roughly parallel to Interstate 264. The Oceanfront extension of the corridor starts at Birdneck Road and stretches along 17th Street and Washington Street to 19th Street and Arctic Avenue. An alternative fixed-guideway alignment through the Hilltop area along Laskin Road to the Oceanfront via Birdneck Road, are considered in this study.

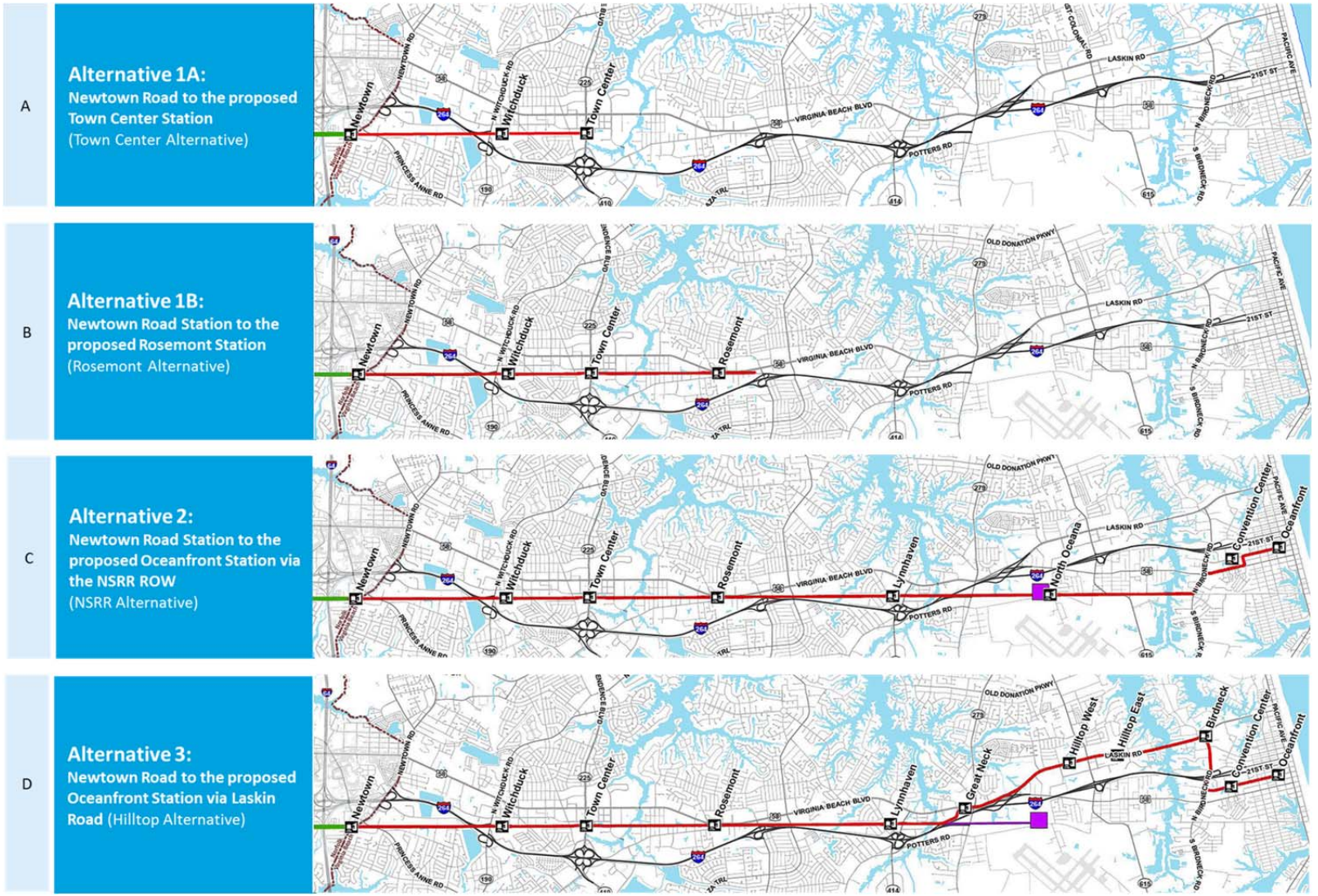
Four alignment alternatives **(Figure 1-2)** were studied each considering the LRT and BRT for a total of eight build alternatives and are described below:

- **Alternative 1A: Newtown Road to the proposed Town Center Station (Town Center Alternative: Figure 1-2.A)** – an alternative alignment from The Tide station at Newtown Road extending east along the former NSRR ROW to a new station in the vicinity of the Town Center of Virginia Beach (approximately 3 miles).
- **Alternative 1B: Newtown Road to proposed Rosemont Station (Rosemont Alternative: Figure 1-2.B)** – an alternative alignment from The Tide station at Newtown Road extending east along the former NSRR ROW to a new station near Rosemont Road (approximately 4.8 miles).
- **Alternative 2: Newtown Road to the proposed Oceanfront Station via the NSRR ROW (NSRR Alternative: Figure 1-2.C)** - an alternative alignment from The Tide station at Newtown Road

extending east to the Oceanfront Resort Area largely along the former NSRR ROW and including segments along Birdneck Road, 17th Street, Washington Street, and 19th Street (approximately 12.2 miles).

- **Alternative 3: Newtown Road to the proposed Oceanfront Station via Laskin Road (Hilltop Alternative: Figure 1-2.D)** - an alternative alignment from The Tide station at Newtown Road extending east through the Hilltop SGA and then to the Oceanfront Resort Area via Birdneck Road and 19th Street (approximately 13.5 miles).

Figure 1-2| Alignment Alternatives



Source: HDR Engineering, 2014

2.0 STUDY METHODOLOGY

The traffic analysis methodology for the VBTES area consists of the development of existing traffic volumes, future traffic volumes, traffic model development, and performance measures and is summarized in this section.

Traffic operations data was obtained from the City of Virginia Beach, the Hampton Roads Transportation Planning Organization (HRTPO), and the Virginia Department of Transportation (VDOT). Data gathered for this study included recent traffic counts where available, travel demand model outputs, traffic signal timing data, and roadway geometric data. HRTPO's Transportation Improvement Plan (TIP) and the City's Capital Improvement Plan (CIP) were reviewed to determine locations of known planned and/or programmed (funded) transportation improvements within the VBTES Corridor. The study locations considered for this evaluation are shown in **Figure 2-1**.

2.1 Development of Existing Traffic Volumes (2013)

The traffic analysis focuses on traffic operations during the morning (AM) and afternoon peak (PM) hours, which typically consist of higher percentages of commuter traffic as well as higher traffic volumes overall. Available traffic counts in the VBTES Corridor were assembled from the City's 2009 traffic signal optimization study and the City of Virginia Beach's Traffic Count Database System (TCDS). This database system contains 24-hour traffic counts and intersection turning movement counts, usually data collected on a Tuesday, Wednesday, or Thursday, at various locations in the City. The counts are raw data and are unadjusted; thus, the data does not account for seasonal adjustments or other variations.

Where count data were not available through the TCDS, traffic volumes were either collected or interpolated and distributed based on existing morning and afternoon peak hour travel patterns from the nearest study area intersection with available counts. At specific locations, weekday morning (7:00 AM to 9:00 AM) and evening (4:00 PM to 6:00 PM) peak period intersection turning movement counts were collected at the study intersections in May and June of 2013. The counts were conducted on a clear day in which area schools were in session. In addition to morning and evening peak period intersection counts, 24-hour daily volume counts were collected at locations where TCDS data was unavailable.

The traffic volumes in the City's 2009 traffic signal optimization study were assumed to represent 2013 conditions, as traffic in the VBTES Corridor has remained reasonably constant due to economic conditions. Existing traffic volumes are shown in the Appendix.

2.2 Development of Future Traffic Volumes (2034)

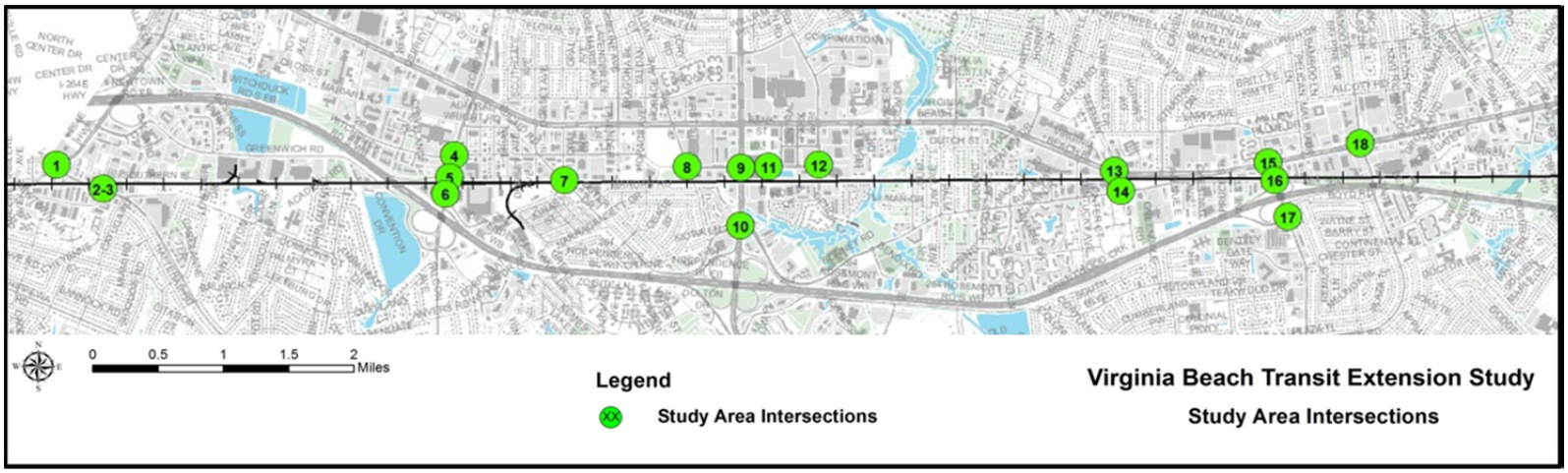
For planning purposes, a 1.05% per year growth rate was applied to existing (2013) traffic volumes to establish forecast year (2034) conditions. This rate was derived using data from the Hampton Roads Regional Travel Demand Model and discussions with the City of Virginia Beach Public Works/Traffic Engineering Division. Future traffic volumes are shown in the Appendix.

2.2.1 Future Traffic Volumes at Proposed New Signals

In the development of the alternatives, it was determined that new traffic signals were required at locations to improve pedestrian and vehicle safety and minimize automobile impacts that would be associated with each alternative.

The traffic demand at each location was conservatively estimated using the following process: (1) traffic volume was interpolated from the nearest study area intersection, (2) cross street traffic was based on the abutting land use context, and (3) directional traffic distribution was based off AM and PM peak hour travel patterns in the study area. Signal timing information from adjacent study area traffic signals was replicated for each new signal and the phasing scheme was based upon the proposed lane configuration. Traffic demand from each driveway or cross street was held constant between existing and future conditions due to low traffic volumes with the exception of access to the proposed park-n-ride lots. In this case, the future travel demand was estimated based upon the proposed number of parking spaces.

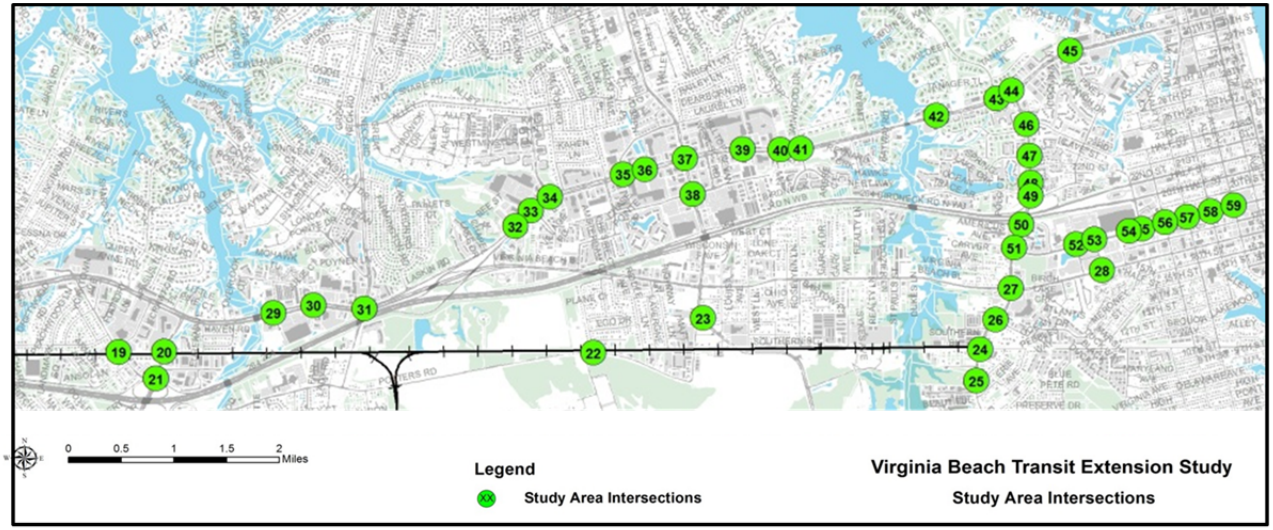
Figure 2-1| Study Area Intersections



Study Area Intersections

1. Princess Anne Road and Newtown Road
2. Princess Anne Road and Freight Lane
3. Southern Boulevard and Freight Lane
4. Witchduck Road and Cleveland Street
5. Witchduck Road and Southern Boulevard/I-264 WB On-Ramp
6. Witchduck Road and Mac Street
7. Southern Boulevard and Euclid Road/Opal Avenue
8. Columbus Street and Kellam Road
9. Independence Boulevard and Columbus Street
10. Independence Boulevard and Bonney Road/Euclid Road
11. Market Street and Columbus Street
12. Columbus Street and Constitution Drive
13. Lynn Shores Drive and Virginia Beach Boulevard
14. Lynn Shores Drive and Bonney Road
15. Virginia Beach Boulevard and Rosemont Road
16. Rosemont Road and Bonney Road/I-264 WB Off-Ramp
17. Rosemont Road and I-264 EB Ramps
18. North Plaza Trail and Virginia Beach Boulevard

Figure 2-1| Study Area Intersections (continued)



Study Area Intersections

19. N. Lynnhaven Road and Southern Boulevard
20. Lynnhaven Parkway and Southern Boulevard
21. Lynnhaven Parkway and Lynnhaven Road/I-264 WB Off-Ramp
22. Potters Road and Air Station Drive
23. First Colonial Road and Oceana Boulevard
24. Birdneck Road and Norfolk Avenue/Southern Boulevard
25. Birdneck Road and Burford Avenue
26. Birdneck Road and Hope Avenue
27. Birdneck Road and Virginia Beach Boulevard/17th Street
28. Virginia Beach Boulevard and Jefferson Avenue
29. Virginia Beach Boulevard and Hutton Lane/Parker Lane
30. Virginia Beach Boulevard and Byrd Lane
31. Virginia Beach Boulevard and Great Neck Road/London Bridge Road
32. Laskin Road and Phillip Avenue
33. Laskin Road and Regency Hilltop Shopping Center
34. Laskin Road and Regency Drive
35. Laskin Road and Republic Road
36. Laskin Road and Hilltop Plaza Shopping Center
37. Laskin Road and First Colonial Road
38. First Colonial Road and Donna Boulevard
39. Laskin Road and Hilltop North Shopping Center

Study Area Intersections

40. Laskin Road and Hilltop East Shopping Center
41. Laskin Road and Winwood Drive
42. Laskin Road and Linkhorn Bay Condominium Entrance
43. Laskin Road and Cardinal Road
44. Laskin Road and Birdneck Road
45. Laskin Road and Oriole Drive
46. Birdneck Road and 24th Street
47. Birdneck Road and Waterfront Drive
48. Birdneck Road and Maximus Square
49. Birdneck Road and Old Virginia Beach Boulevard
50. Birdneck Road and I-264 EB Off-Ramp
51. Birdneck Road and 19th Street/Americus Avenue
52. 19th Street and West Convention Center Parking Lot Entrance
53. 19th Street and East Convention Center Parking Lot Entrance
54. 19th Street and Convention Center
55. 19th Street and Parks Avenue
56. 19th Street and Cypress Avenue
57. 19th Street and Mediterranean Avenue
58. 19th Street and Baltic Avenue
59. 19th Street and Artic Avenue

2.3 Synchro Model Development

The operational analysis for the study area intersections was completed using Synchro 8.0, a computer-based operations model that replicates procedures from the Highway Capacity Manual (HCM) 2000 and 2010, Transportation Research Board.

The network was developed using aerial mapping, and lane geometry was confirmed through field visits. Traffic data and signal timing information were entered into the model. Synchro was used to develop new timing and phasing schemes for intersections that need to be modified to accommodate safe and efficient transit operations and transitions. Signal timing was optimized for each corridor to accommodate the transit systems.

The following ***assumptions*** were considered for the future condition analyses:

- The traffic volumes and signal data collected in the City's 2009 traffic signal optimization study were assumed to represent 2013 conditions, as traffic in the VBTES Corridor has remained relatively constant due to recent economic conditions. At locations where traffic volumes were not available, new traffic volumes were either collected or interpolated and distributed based on existing morning and afternoon peak hour travel patterns from the nearest study area intersection with available counts.

- The Hampton Roads Regional Travel Demand Model was used to derive the rate of growth for traffic between the current year (2013) and the forecast year (2034).

- The train frequency will be 10 minute headways during the morning and afternoon peak hours, resulting in 6 trains per peak hour in each direction (total of 12 trains per peak hour).

- Train control (for LRT alternatives) or bus control (for BRT alternatives) at currently signalized at-grade crossings would require automated crossing gates. These gates would pre-empt (alter) the normal red-yellow-green cycle of the intersection to give priority to the passing transit vehicle. This is the most conservative approach to vehicle operations and shows the highest level of potential impacts. Traffic crossing the tracks/busway would be stopped while traffic parallel to the tracks/busway would be allowed to continue. It is anticipated that the operation of the crossing gates would be approximately 35 seconds. These operating assumptions will be revisited during later phases of design as part of the engineering analysis of each crossing.

- The future year Synchro models include roadway ad geometry changes as a result of planned and programmed projects.

- Standard traffic signal warrant analyses in accordance with the Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) were not conducted. However, to increase pedestrian and vehicle safety and avoid potential traffic conflicts with the transit system operations, signalization at specific locations are included as part of the Build analyses.

2.4 Performance Measures

The key roadway and traffic measures of effectiveness for this analysis are intersection delay as measured by level of service (LOS).

LOS is a qualitative measure of intersection operations and takes into account a number of operational conditions in the travel stream and the perception of those conditions by motorists. Speed and travel time are the primary measures that are perceived by motorists and LOS attempts to describe the level of inconvenience or frustration that motorists perceive as operating conditions deteriorate. Six levels of service are defined with letter designations from A to F, with LOS A representing the best operating conditions, LOS B and C representing stable operating conditions with delays, LOS D representing noticeable delays, and LOS E and F representing the worst condition of traffic congestion and high delays.

The City of Virginia Beach has identified LOS D as the minimum acceptable level of service for design purposes. For this analysis, intersections that operate or would operate in the forecast year below LOS D (LOS E or F) have been identified as below standard. LOS is determined differently for signalized and unsignalized (stop sign controlled) intersections. This is due primarily to driver expectations and behavior. For signalized intersections, LOS is a measure of driver discomfort and frustration, and lost travel time for all movements through an intersection. For unsignalized intersections, delay is measured only for the street that is stopped and waiting to turn in to or across the unstopped road. **Table 2-1** summarizes the intersection LOS criteria, as specified by the Highway Capacity Manual.

Table 2-1| Intersection Level of Service Criteria

	Description of Condition	Level of Service (LOS)	Signalized Intersection Control Delay (seconds/vehicle)	Unsignalized Intersection Control Delay (seconds/vehicle)
Delay meets standards	Few delays at intersection	A	0-10	0-10
	Slight level of delay	B	>10-20	> 10-15
	Fair level of delay	C	>20-35	>15-25
	Noticeable delay	D	>35-55	>25-35
Delay exceeds standards	Signal cycles frequently fail	E	>55-80	>35-50
	Over capacity	F	>80	>50

Source: 2000 Highway Capacity Manual (Special Report 209)

3.0 EXISTING CONDITIONS

This chapter describes the existing conditions of the roadway facilities in the vicinity of the VBTES Corridor. It also presents existing traffic volumes and operations for the study intersections with the results of level of service calculations.

3.1 Existing Transportation Network

The existing roadway network in the VBTES area links a variety of land uses together to easily access neighboring residential, retail, employment and recreation destinations. These roadways are important to the region's overall transportation network and have classified each for maintenance and improvement purposes.

3.1.1 Functional Classification

VDOT is responsible for maintaining the Commonwealth's official Federal Functional Classification System. The functional classification of the road is determined by type of trips, expected volume, what systems the roadway connects with. According to the Federal Highway Administration (FHWA), the three general functional systems are arterials, collectors, and local streets. Most state and local agencies adhere to this functional classification system, which is required for allocating federal funding to roads designated as part of the Nation Highway System. The following briefly describes each functional system's traffic service they are intended to provide.

- **Arterial:** Provides the highest level of service at the greatest speed for the longest uninterrupted distance, with some degree of access control.
- **Collector:** Provides a less highly developed level of service at a lower speed for shorter distances by collecting traffic from local roads and connecting them with arterials.
- **Local:** Consists of all roads not defined as arterials or collectors; primarily provides access to land with little or no through movement

While arterials, collectors, and local roads span the full range of roadway functions, the Federal and at times local functional classification scheme uses additional categories to describe these functions more precisely. Distinctions between access-controlled and full-access roadways; the urban and rural development pattern; and subtleties between "principal" and "minor" sub-classifications are key considerations when determining the Federal functional classification category to which a particular roadway belongs.

3.1.2 Major Roadways

Several key roads and one interstate highway carry significant roadway capacity and create the network that carries people and goods through corridor. The major roadways are described below.

I-264 is a 26-mile-long east-west Interstate Highway that originates in the Bowers Hill section of the City of Chesapeake, runs east into the City of Portsmouth and, through the Downtown Tunnel, and under the South Branch of the Elizabeth River into Norfolk. It is parallel to Virginia Beach Boulevard and runs through the City of Virginia Beach until its terminus near the Oceanfront as the 21st Street and 22nd Street one-way pair at Pacific Avenue. I-264 in Virginia Beach operates as the Virginia Beach Expressway, an eight-lane freeway where the innermost lane in each direction is a High Occupancy Vehicle (HOV) lane. Existing traffic levels on I-264 through the VBTES area ranges from 30,000 daily trips to over 180,000 daily trips.

Virginia Beach Boulevard is a 45 mph six to eight-lane divided roadway - with median – that parallels I-264. The eight-lane portions west of Laskin Road are classified as a Principal Arterial. Virginia Beach Boulevard diverges from Laskin Road as it moves southeast and continues to run parallel to I-264, terminating at 17th Street. Near Independence Boulevard, Virginia Beach Boulevard serves approximately 45,000 vehicles per day. This split changes the eight-lane Virginia Beach Boulevard into two four-lane roadways and its roadway classification transitions from Principal Arterial to Minor Arterial. The four-lane segment of Virginia Beach Boulevard has a 45 mph speed limit and carries roughly 14,000 vehicles per day. There are many different land uses along the roadway; residential, commercial, retail and industrial uses share Virginia Beach Boulevard frontage.

Witchduck Road is a four-lane divided roadway - with median - classified as a Minor Arterial. Witchduck Road originates just north of Virginia Beach Boulevard and runs south providing interchange access to I-264. Abutting land uses north of Virginia Beach Boulevard consist of residential developments while commercial and retail land uses flank both sides of Witchduck Road approaching I-264. It is a congested roadway with average daily traffic that far exceeds its functional capacity. The segment of Witchduck Road located with the study area serves over 50,000 vehicles per day.

Independence Boulevard is a 45 mph eight-lane divided roadway - with median - classified as a Principal Arterial. Independence Boulevard originates north of Virginia Beach Boulevard and runs northeast to I-264. Commercial and retail land uses are prevailing and flank both sides of Independence Boulevard. It is a congested roadway with average daily traffic that exceeds 70,000 vehicles per day.

Rosemont Road is a four-lane divided roadway - with median - classified as a Minor Arterial. Rosemont Road originates just north of Virginia Beach Boulevard and runs south providing interchange access to I-264. Abutting land uses south of I-264 consist of residential developments while commercial and retail land establishments flank both sides of Rosemont Road between I-264 and Virginia Beach Boulevard. It is a congested roadway with average daily traffic that will soon exceed its functional capacity with long-term plans to potentially widen to six lanes. The segment of Rosemont Road located with the VBTES Corridor serves approximately 35,000 vehicles per day.

Great Neck Road is a 35 mph four-lane divided roadway - with median - classified as a Minor Arterial. Great Neck Road originates just north of Virginia Beach Boulevard and runs northeast to Shore Drive. It becomes a six-lane divided roadway at its intersection with First Colonial Road, north of the study area. Commercial, retail and residential land uses flank both sides of Great Neck Road. Residential

development is the prevailing land use in the Great Neck area with Great Neck Road connecting residents to the Shore Drive commercial center to the north and Hilltop to the south. The segment of Great Neck Road located with the study area and serves approximately 39,000 vehicles per day.

Laskin Road is a four-lane divided roadway combined with a bi-directional collector-distributor (CD) system with a posted 45 mph speed limit. It splits from Virginia Beach Boulevard just east of Great Neck Road and moves northeast, terminating at 31st Street at the Oceanfront. The CD roads provide local access to smaller intersecting streets, and to adjacent properties with numerous driveways. It is considered an Urban Principal Arterial and serves many of the major points of interest and activity centers in the Hilltop SGA. Urban Principal Arterials tend to have the highest traffic volume, carry significant amounts of intra-area travel, carry a high proportion of the total urban area travel on a minimum of mileage and carry a high proportion of the total area traveled with the fewest miles. Laskin Road features all of these characteristics and carries more cars than it was designed to. Laskin Road at First Colonial Road registers over 36,000 vehicles per day.

First Colonial Road is also classified as a Minor Arterial road. This four-lane divided road has left turn pockets and a 35 mph posted speed limit. It begins as Oceana Boulevard and just south of Virginia Beach Boulevard becomes First Colonial Road as it continues north, bisecting the Hilltop area, and terminates at the Great Neck Road intersection. First Colonial Road at Laskin Road is considered the nexus of the Hilltop SGA and the average daily traffic recorded just north of this intersection effectively illustrates just how busy this commercial district; it is averaging 40,000 daily trips.

Birdneck Road is a 90-foot wide, 35 mph four-lane divided roadway with left-turn pockets classified as a Minor Arterial. It is one of only two major, non-interstate roadways in the corridor that run north-south. Birdneck Road primarily runs through multi-family residential developments with small strip shopping centers located at key intersections. It measure 30,000 vehicles per day.

The major roadways in the VBTES Corridor along with the VDOT functional classification, number of lanes, ADT, and speed limits are shown in **Table 3-1**.

Table 3-1| Existing Roadway Characteristics

Roadway	VDOT Classification[1]	Number of Lanes	Speed Limit[2]	Weekday ADT[3]	Weekend ADT[3]	Count Year
I-264*	Interstate Highway	8	55	90,000	N/A	2012
Newtown Road	Local	2	35	11,900	9,500	2013
Princess Anne Road*	Minor Arterial	4	35	30,500	22,000	2012
Greenwich Road	Collector	2	35	7,100	3,100	2013
Witchduck Road, N.*	Minor Arterial	4	35	53,500	37,500	2012
Euclid Road	Collector	2	35	6,100	3,900	2013
Independence Boulevard, N.*	Principal Arterial	8	45	62,500	50,000	2012
Independence Boulevard, S.*	Principal Arterial	8	45	75,500	N/A	2012
Virginia Beach Boulevard*	Principal Arterial	8	45	45,000	42,000	2013/2011
First Avenue	Local	2	25	820	710	2013
Thalia Road	Local	2	25	2,800	1,950	2013
Budding Avenue	Local	2	25	560	490	2013
Kentucky Avenue	Local	2	25	6,000	5,300	2013
Lynn Shores Drive	Local	4	25	4,100	3,500	2013
Rosemont Road	Minor Arterial	4	35	35,000	N/A	2013
S. Plaza Trail	Minor Arterial	4	25	14,300	13,800	2013
N. Lynnhaven Road	Local	2	35	11,300	8,500	2013
Lynnhaven Parkway*	Minor Arterial	4	35	22,000	25,500	2012/2011
London Bridge Road*	Minor Arterial	6	45	39,000	28,000	2013/2012

Roadway	VDOT Classification[1]	Number of Lanes	Speed Limit[2]	Weekday ADT[3]	Weekend ADT[3]	Count Year
Potters Road*	Collector	2	45	4,000	3,000	2013
Air Station Drive	Local	2	25	850	710	2013
First Colonial Road, S.*	Collector	2	35	4,500	3,000	2013
Laskin Road*	Principal Arterial	4	45	31,000	29,000	2013
Birdneck Rd., N.*	Minor Arterial	4	35	31,000	29,000	2013
19th Street*	Collector	4	25	5,000	8,000	2012/2013

[1]2005 VDOT Functional Classification Maps
[2]Posted speed limit sign within the immediate study area
[3]Does not reflect seasonal adjustments
**City of Virginia Beach ATR Count*
N/A: No count available

3.2 Existing Condition

Table 3.2 and **Figure 3-1** shows the 58 intersections (39 signalized, 19 unsignalized) that were studied as part of the traffic analysis. As shown in the table, 15 intersections currently operate at LOS E or F during the morning or afternoon peak hours. They are:

- Princess Anne Road and Freight Lane
- Witchduck Road and Cleveland Street
- Witchduck Road and I-264 WB On-Ramp
- Witchduck Road and Mac Street
- Independence Boulevard and Columbus Street
- Independence Boulevard and Bonney Road/Euclid Road
- Lynn Shores Drive and Bonney Road
- Virginia Beach Boulevard and Rosemont Road
- Lynnhaven Parkway and Southern Boulevard
- Virginia Beach Boulevard and Great Neck Road/London Bridge Road
- Laskin Road and Philip Avenue
- Laskin Road and Winwood Drive
- Laskin Road and Linkhorn Bay Condominium Entrance
- Birdneck Road and Maximus Square
- Birdneck Road and Old Virginia Beach Boulevard

The remaining intersections operate at LOS D or better under Existing Conditions. In general, traffic flows reasonably well for an urban network. Heavy traffic demand can be associated with arterials paralleling I-264 and interchange access within the study corridor contributing to congestion at nearby intersections.

Table 3-2| Existing Condition Intersection Level of Service Summary

Alternative						Existing Condition (2013)	
						AM Peak Hour	PM Peak Hour
1A	1B	2	3	Intersection	Control Type[1]	LOS	LOS
●	●	●	●	Princess Anne Road and Newtown Road	Signal	C	D
●	●	●	●	Princess Anne Road and Freight Lane	SSSC	F	F
●	●	●	●	Southern Boulevard and Freight Lane	SSSC	A	B
●	●	●	●	Witchduck Road and Cleveland Street	Signal	E	F
●	●	●	●	Witchduck Road and Southern Boulevard/I-264 WB On-Ramp	SSSC	F	F
●	●	●	●	Witchduck Road and Mac Street	SSSC	F	F
●	●	●	●	Southern Boulevard and Euclid Road/Opal Avenue	SSSC	C	C
●	●	●	●	Columbus Street and Kellam Road	Signal	A	B
●	●	●	●	Independence Boulevard and Columbus Street	Signal	C	E
●	●	●	●	Independence Boulevard and Bonney Road/Euclid Road	Signal	E	F
●	●	●	●	Market Street and Columbus Street	Signal	B	B
●	●	●	●	Columbus Street and Constitution Drive	Signal	C	C
	●	●	●	Lynn Shores Drive and Virginia Beach Boulevard	Signal	A	B
	●	●	●	Lynn Shores Drive and Bonney Road	SSSC	D	F
	●	●	●	Virginia Beach Boulevard and Rosemont Road	Signal	E	E
	●	●	●	Rosemont Road and Bonney Road/I-264 WB Off-Ramp	Signal	C	C
	●	●	●	Rosemont Road and I-264 EB Ramps	Signal	C	C
		●	●	North Plaza Trail and Virginia Beach Boulevard	Signal	D	D
		●	●	N. Lynnhaven Road and Southern Boulevard	SSSC	B	C
		●	●	Lynnhaven Parkway and Southern Boulevard	SSSC	E	F
		●	●	Lynnhaven Parkway and Lynnhaven Road/I-264 WB Off-Ramp	Signal	C	C
		●		Potters Road and Air Station Drive	SSSC	A	B
		●		First Colonial Road and Oceana Boulevard	Signal	B	C
		●		Birdneck Road and Norfolk Avenue/Southern Boulevard	Signal	C	C
		●		Birdneck Road and Burford Avenue	Signal	A	B
		●		Birdneck Road and Hope Avenue	SSSC	C	C
		●		Birdneck Road and Virginia Beach Boulevard/17th Street	Signal	C	C
		●		Virginia Beach Boulevard and Jefferson Avenue	SSSC	B	D
			●	Virginia Beach Boulevard and Hutton Lane/Parker Lane	Signal	B	B
			●	Virginia Beach Boulevard and Byrd Lane	Signal	B	C
			●	Virginia Beach Boulevard and Great Neck Road/London Bridge Road	Signal	F	F
			●	Laskin Road and Phillip Avenue	SSSC	F	F
			●	Laskin Road and Regency Hilltop Shopping Center	Signal	A	A
			●	Laskin Road and Regency Drive	Signal	C	C
			●	Laskin Road and Republic Road	Signal	B	C
			●	Laskin Road and Hilltop Plaza Shopping Center	Signal	A	B

[1]SSSC: Side street stop controlled

Source: Fitzgerald & Halliday, Inc., 2014

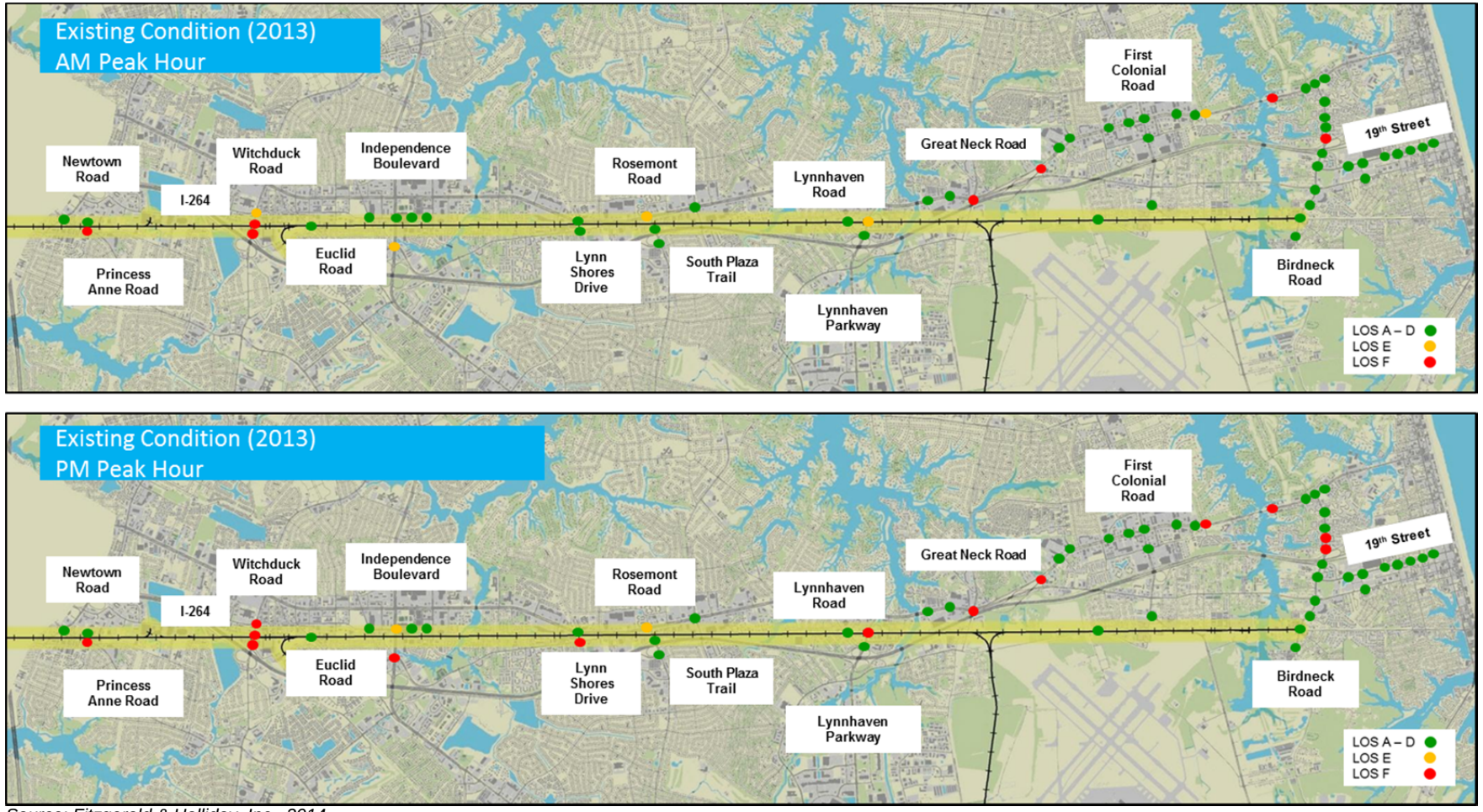
Table 3-2| Existing Condition Intersection Level of Service Summary (continued)

Alternative						Existing Condition (2013)	
						AM Peak Hour	PM Peak Hour
1A	1B	2	3	Intersection	Control Type[1]	LOS	LOS
			●	Laskin Road and First Colonial Road	Signal	D	D
			●	First Colonial Road and Donna Boulevard	Signal	B	C
			●	Laskin Road and Hilltop North Shopping Center	Signal	B	C
			●	Laskin Road and Hilltop East Shopping Center	Signal	A	B
			●	Laskin Road and Winwood Drive	SSSC	E	F
			●	Laskin Road and Linkhorn Bay Condominium Entrance	SSSC	F	F
			●	Laskin Road and Cardinal Road	Signal	B	A
			●	Laskin Road and Birdneck Road	Signal	C	C
			●	Laskin Road and Oriole Drive	Signal	B	B
			●	Birdneck Road and 24th Street	Signal	A	A
			●	Birdneck Road and Waterfront Drive	Signal	B	A
			●	Birdneck Road and Maximus Square	SSSC	D	F
			●	Birdneck Road and Old Virginia Beach Boulevard	SSSC	F	F
			●	Birdneck Road and I-264 EB Off-Ramp	Signal	A	B
			●	Birdneck Road and 19th Street/Americus Avenue	Signal	A	B
			●	19th Street and West Convention Center Parking Lot Entrance	SSSC	B	B
			●	19th Street and East Convention Center Parking Lot Entrance	Signal	B	B
		●	●	19th Street and Parks Avenue	Signal	A	A
		●	●	19th Street and Cypress Avenue	SSSC	B	B
		●	●	19th Street and Mediterranean Avenue	SSSC	B	C
		●	●	19th Street and Baltic Avenue	Signal	B	B
		●	●	19th Street and Artic Avenue	Signal	B	A

[1]*SSSC: Side street stop controlled*

Source: Fitzgerald & Halliday, Inc., 2014

Figure 3-1| Existing Condition Intersection Level of Service Summary



Source: Fitzgerald & Halliday, Inc., 2014

4.0 FUTURE NO BUILD CONDITIONS

This chapter describes the transportation network and operations anticipated in the year 2034 without the proposed transit extension.

4.1 Future Transportation Network

The future transportation network includes all highway and transit facilities and services of the existing transportation system, plus highway and transit improvements from the financially-constrained *2034 Long-Range Transportation Plan* (HRTPO, June 2012), proposed short-range transit service and capital improvements, and the City of Virginia Beach approved development projects. Regardless of whether or not a VBTES Build Alternative is implemented, the projects would be funded and implemented.

Upon review with the City of Virginia Beach, transportation improvements on Witchduck Road, Laskin Road, and Kellam Road would affect the VBTES Corridor and are considered for the traffic analysis evaluation. These improvements were included in the future Synchro models and are summarized below. The VDTO functional classification, number of lanes, ADT, and speed limits on the major roadways in the VBTES Corridor are shown in **Table 4-1**.

4.1.1 Witchduck Road Area

The HRTPO and VDOT have identified transportation improvements on Witchduck Road from I-264 to Virginia Beach Boulevard in the *Hampton Roads 2030 Amended Long-Range Transportation Plan*. The plan is to widen the roadway to six lanes (three travel lanes in each direction) and provide additional turning capacity at signalize intersections. Therefore, the following VBTES intersections are anticipated to be impacted by the Witchduck Road project:

- Witchduck Road and Cleveland Street
- Witchduck Road and Southern Boulevard/I-264 WB On-Ramp
- Witchduck Road and Mac Street

As part of this project, Southern Boulevard will become realigned with the intersection of Witchduck Road and I-264 WB On-Ramp. Mac Street will become a cul-de-sac street at Witchduck Road, thereby removing access and a potential VBTES intersection. The proposed transportation improvements and alignments are shown in the **Appendix**.

4.1.2 Laskin Road Area

The HRTPO and VDOT have identified transportation improvements on Laskin Road from 0.2 miles west of First Colonial Road to 0.3 miles east of Birdneck Road. The plan is to widen the roadway and remove/re-purpose the access roadway network that runs parallel to Laskin Road. Therefore, the following VBTES intersections are anticipated to be impacted by the Laskin Road widening project:

- Laskin Road and Republic Road
- Laskin Road and Hilltop Plaza Shopping Center
- Laskin Road and First Colonial Road
- Laskin Road and Hilltop North Shopping Center
- Laskin Road and Hilltop East Shopping Center
- Laskin Road and Cardinal Road
- Laskin Road and Birdneck Road
- Laskin Road and Oriole Drive

In general, the VBTES intersections near First Colonial Road will be impacted through the addition of two travel lanes in each direction along Laskin Road and the elimination of the frontage roads. Additional improvements are planned for First Colonial Road; however, the improvements are not within the VBTES Corridor. Only the approach configuration at the intersection on First Colonial and Laskin Road was modified for the purposes of this study.

The Laskin Road widening project will transition from eight lanes to six lanes near the eastern extent of Laskin Road, thereby impacting the adjacent intersections at Birdneck Road through the addition of one travel lane in each direction. The proposed transportation improvements and alignments are shown in **Appendix**.

4.1.3 Walmart Supercenter

This section summarizes the findings of the Traffic Impact Analysis (TIA) that was completed in May 2013 for the proposed Walmart Supercenter located in Virginia Beach, Virginia. The proposed free-standing discount superstore is located in the southwest quadrant of Virginia Beach Boulevard at the Kellam Road intersection, within the VBTES area. The purpose of this study was to determine the potential impacts to the surrounding transportation system caused by the traffic generated by the proposed store. Based on the traffic capacity analysis and findings of this study, the following roadway and traffic signal improvements impact the study area:

Columbus Street at Kellam Road:

- Adjust phase splits within existing cycle length
- Restripe Kellam Road to provide a southbound left-turn lane with 120 feet of storage and a 50 foot taper shared with the northbound left turn lane at Site Drive 1

Table 4-1| Future Roadway Characteristics

Location	VDOT Classification[1]	Number of Lanes	Speed Limit[2]	Weekday ADT[3]	Weekend ADT[3]
I-264*	Interstate Highway	8	55	112,500	N/A
Newtown Road	Local	2	35	15,000	12,000
Princess Anne Road*	Minor Arterial	4	35	38,000	27,500
Greenwich Road	Collector	2	35	9,000	4,000
Witchduck Road, N.*	Minor Arterial	4	35	67,000	47,000
Euclid Road	Collector	2	35	7,500	5,000
Independence Boulevard, N.*	Principal Arterial	8	45	78,000	62,500
Independence Boulevard, S.*	Principal Arterial	8	45	94,000	N/A
Virginia Beach Boulevard*	Principal Arterial	8	45	56,000	52,500
First Avenue	Local	2	25	1,000	1,000
Thalia Road	Local	2	25	3,500	2,500
Budding Avenue	Local	2	25	750	500
Kentucky Avenue	Local	2	25	7,500	6,500
Lynn Shores Drive	Local	4	25	5,000	4,500
Rosemont Road	Minor Arterial	4	35	44,000	N/A
S. Plaza Trail	Minor Arterial	4	25	18,000	17,500
N. Lynnhaven Road	Local	2	35	14,000	10,500
Lynnhaven Parkway*	Minor Arterial	4	35	27,500	32,000
London Bridge Road*	Minor Arterial	6	45	49,000	35,000
Potters Road*	Collector	2	45	5,000	4,000
Air Station Drive	Local	2	25	1,000	1,000
First Colonial Road, S.*	Collector	2	35	5,500	4,000
Laskin Road*	Principal Arterial	8	45	39,000	36,000
Birdneck Rd., N.*	Minor Arterial	4	35	39,000	36,000
19th Street*	Collector	4	25	6,000	10,000

[1]2005 VDOT Functional Classification Maps
[2]Posted speed limit sign within the immediate study area
[3]Does not reflect seasonal adjustments
**City of Virginia Beach ATR Count*
N/A: No count available
Source: Fitzgerald & Halliday, Inc., 2014

4.2 No Build Alternative

No Build conditions represent traffic from existing conditions, known planned improvements, and the application of the future growth rate. Results from the 2034 No Build analysis, shown in **Table 4-2 and Figure 4-1**, indicate that 17 of the study area intersections would operate at LOS E or F during the morning or after-noon peak hours.

Of the 17, five are new intersections compared to the existing (2013) conditions. They are:

- Princess Anne Road and Newtown Road
- Rosemont Road and Bonney Road/I-264 Westbound Off-Ramp
- North Plaza Trail and Virginia Beach Boulevard
- Birdneck Road and Norfolk Avenue/Southern Boulevard
- Virginia Beach Boulevard and Jefferson Avenue

Planned improvements on Witchduck Road would cause two intersections that currently (2013) operate at LOS E or F to operate under acceptable conditions in the forecast year (2034). They are:

- Witchduck Road and Cleveland Street
- Witchduck Road and I-264 Westbound On-Ramp/realigned Southern Boulevard

The intersection of Witchduck Road and Mac Street would be closed as part of the planned improvements. The remaining VBTES Corridor intersections operate at LOS D or better under No Build Conditions.

Table 4-2| No Build Alternative Intersection Level of Service Summary

Alternative						No Build Condition (2034)	
						AM Peak Hour	PM Peak Hour
1A	1B	2	3	Intersection	Control Type[1]	LOS	LOS
●	●	●	●	Princess Anne Road and Newtown Road	Signal	D	F
●	●	●	●	Princess Anne Road and Freight Lane	SSSC	F	F
●	●	●	●	Southern Boulevard and Freight Lane	SSSC	A	B
●	●	●	●	Witchduck Road and Cleveland Street	Signal	D	D
●	●	●	●	Witchduck Road and Southern Boulevard/I-264 WB On-Ramp	SSSC	B	B
●	●	●	●	Witchduck Road and Mac Street	N/A[2]	N/A[2]	N/A[2]
●	●	●	●	Southern Boulevard and Euclid Road/Opal Avenue	SSSC	D	D
●	●	●	●	Columbus Street and Kellam Road	Signal	B	C
●	●	●	●	Independence Boulevard and Columbus Street	Signal	C	F
●	●	●	●	Independence Boulevard and Bonney Road/Euclid Road	Signal	F	F
●	●	●	●	Market Street and Columbus Street	Signal	B	C
●	●	●	●	Columbus Street and Constitution Drive	Signal	C	C
	●	●	●	Lynn Shores Drive and Virginia Beach Boulevard	Signal	A	B
	●	●	●	Lynn Shores Drive and Bonney Road	SSSC	F	F
	●	●	●	Virginia Beach Boulevard and Rosemont Road	Signal	F	F
	●	●	●	Rosemont Road and Bonney Road/I-264 WB Off-Ramp	Signal	E	D
	●	●	●	Rosemont Road and I-264 EB Ramps	Signal	C	C
		●	●	North Plaza Trail and Virginia Beach Boulevard	Signal	D	E
		●	●	N. Lynnhaven Road and Southern Boulevard	SSSC	C	D
		●	●	Lynnhaven Parkway and Southern Boulevard	SSSC	F	F
		●	●	Lynnhaven Parkway and Lynnhaven Road/I-264 WB Off-Ramp	Signal	C	D
		●		Potters Road and Air Station Drive	SSSC	A	B
		●		First Colonial Road and Oceana Boulevard	Signal	C	C
		●		Birdneck Road and Norfolk Avenue/Southern Boulevard	Signal	E	C
		●		Birdneck Road and Burford Avenue	Signal	A	B
		●		Birdneck Road and Hope Avenue	SSSC	C	C
		●		Birdneck Road and Virginia Beach Boulevard/17th Street	Signal	C	D
		●		Virginia Beach Boulevard and Jefferson Avenue	SSSC	C	E
			●	Virginia Beach Boulevard and Hutton Lane/Parker Lane	Signal	C	C
			●	Virginia Beach Boulevard and Byrd Lane	Signal	B	C
			●	Virginia Beach Boulevard and Great Neck Road/London Bridge Road	Signal	F	F
			●	Laskin Road and Phillip Avenue	SSSC	F	F
			●	Laskin Road and Regency Hilltop Shopping Center	Signal	A	B
			●	Laskin Road and Regency Drive	Signal	C	D
			●	Laskin Road and Republic Road	Signal	B	C
			●	Laskin Road and Hilltop Plaza Shopping Center	Signal	A	B

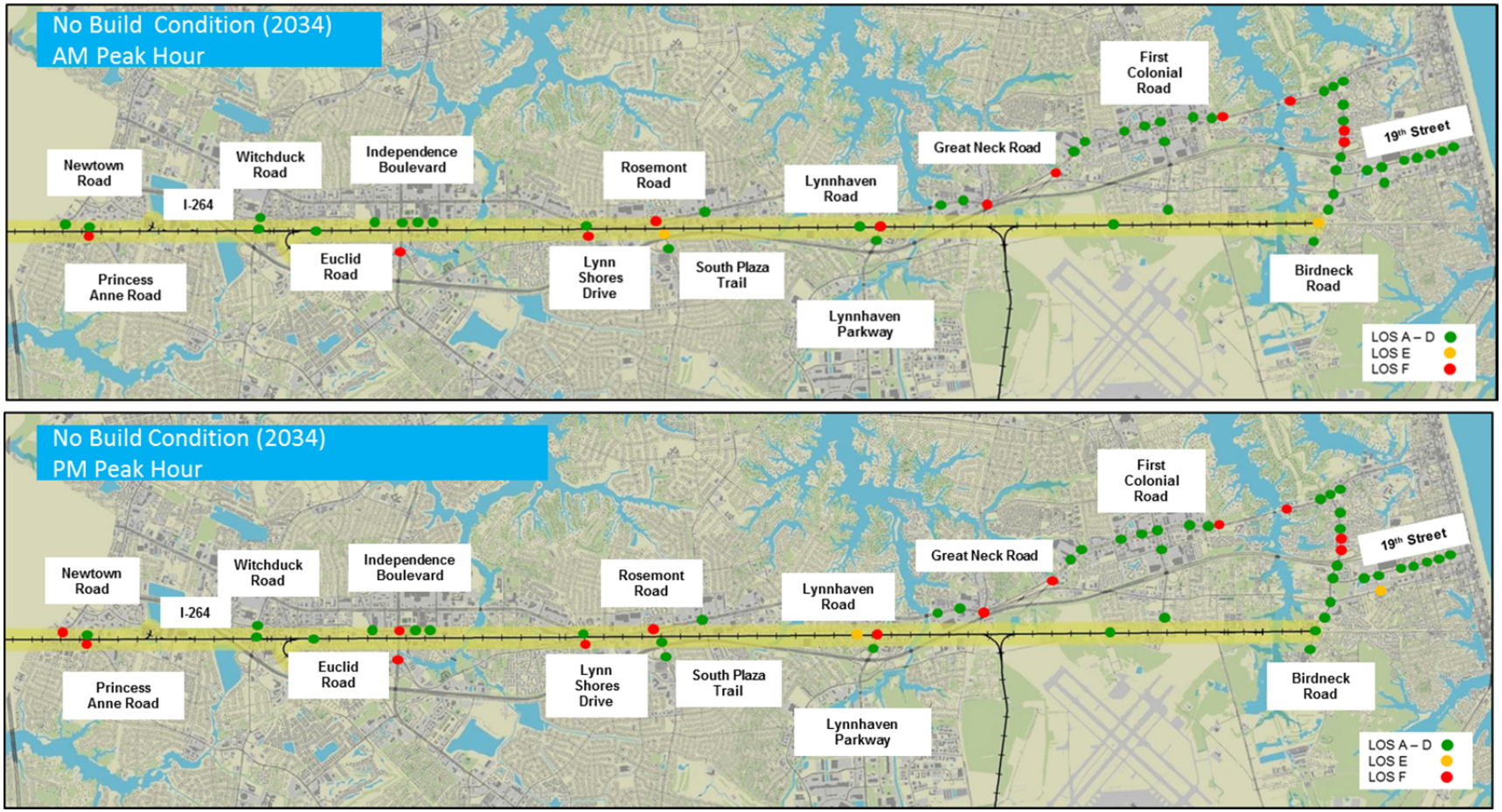
[1]SSSC: Side street stop controlled
N/A[2]: Intersection of Witchduck Road and Mac Street to be closed as part of the Witchduck Road widening project.
Source: Fitzgerald & Halliday, Inc., 2014

Table 4-2| No Build Alternative Intersection Level of Service Summary (continued)

Alternative						No Build Condition (2034)	
						AM Peak Hour	PM Peak Hour
1A	1B	2	3	Intersection	Control Type[1]	LOS	LOS
			●	Laskin Road and First Colonial Road	Signal	D	D
			●	First Colonial Road and Donna Boulevard	Signal	C	D
			●	Laskin Road and Hilltop North Shopping Center	Signal	B	C
			●	Laskin Road and Hilltop East Shopping Center	Signal	A	A
			●	Laskin Road and Winwood Drive	SSSC	F	F
			●	Laskin Road and Linkhorn Bay Condominium Entrance	SSSC	F	F
			●	Laskin Road and Cardinal Road	Signal	B	A
			●	Laskin Road and Birdneck Road	Signal	C	C
			●	Laskin Road and Oriole Drive	Signal	B	B
			●	Birdneck Road and 24th Street	Signal	A	A
			●	Birdneck Road and Waterfront Drive	Signal	B	B
			●	Birdneck Road and Maximus Square	SSSC	F	F
			●	Birdneck Road and Old Virginia Beach Boulevard	SSSC	F	F
			●	Birdneck Road and I-264 EB Off-Ramp	Signal	B	B
			●	Birdneck Road and 19th Street/Americus Avenue	Signal	A	B
			●	19th Street and West Convention Center Parking Lot Entrance	SSSC	B	B
			●	19th Street and East Convention Center Parking Lot Entrance	Signal	B	B
		●	●	19th Street and Parks Avenue	Signal	A	A
		●	●	19th Street and Cypress Avenue	SSSC	B	B
		●	●	19th Street and Mediterranean Avenue	SSSC	B	C
		●	●	19th Street and Baltic Avenue	Signal	B	B
		●	●	19th Street and Artic Avenue	Signal	B	B

[1]SSSC: Side street stop controlled
Source: Fitzgerald & Halliday, Inc., 2014

Figure 4-1| No Build Alternative Intersection Level of Service Summary



Source: Fitzgerald & Halliday, Inc., 2014

5.0 GRADE SEPARATION ANALYSIS

As part of the VBTES planning effort, a grade separation analysis was conducted to determine when the transit system should cross over or cross at-grade at major roadway crossings in the study area for the two full length alignment alternatives that are considered for the full evaluation. This chapter describes the methodology and analysis results to determine when grade separations should be considered at major road/transit crossings along the VBTES Corridor.

As stated in **Section 1-1** there are four alignment alternatives under consideration for the VBTES—Newtown Road Station to the proposed Town Center Station (Town Center Alternative), Newtown Road to the proposed Rosemont Station (Rosemont Alternative), Newtown Road to the proposed Oceanfront Station via the former NSRR ROW (NSRR Alternative), and Newtown Road to the proposed Oceanfront Station via Laskin Road (Hilltop Alternative). The Town Center Alternative would follow the former NSRR ROW from the Tide's Newtown Station to a new station in the vicinity of the Town Center of Virginia Beach. The Rosemont Alternative would follow the former NSRR ROW from The Tide's Newtown Road Station to a new station near Rosemont Road. The NSRR Alternative alignment would extend from The Tide station at Newtown Road extending east to a proposed station at the Oceanfront Resort Area largely following the former NSRR ROW and including segments along Birdneck Road, 17th Street, Washington Avenue, and 19th Street. The Hilltop Alternative alignment would extend from The Tide station at Newtown Road extending east through the Hilltop SGA on Laskin Road and then to a new station in the Oceanfront Resort Area via Birdneck Road and 19th Street.

In coordination with HRT and the City of Virginia Beach, the following crossings were considered as major crossings based on existing and projected traffic load and were selected to be evaluated for this grade separation analysis, as shown **in Table 5-1 and Figure 5-1**.

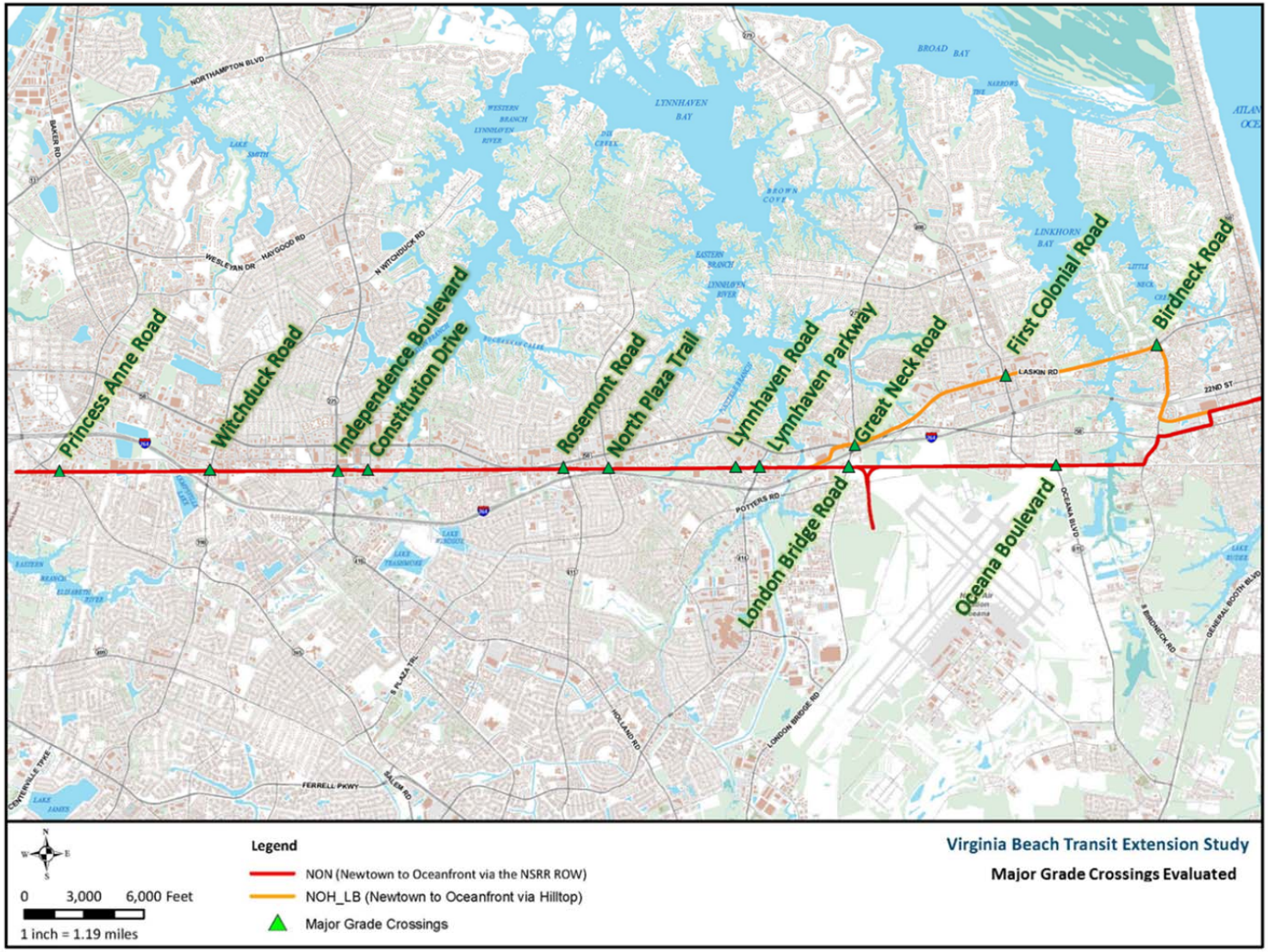
Table 5-1| Major Grade Crossings Evaluated

Major Crossings Evaluated	Alternative 1A Town Center Alternative	Alternative 1B Rosemont Alternative	Alternative 2 NSRR Alternative	Alternative 3 Hilltop Alternative
1. Princess Anne Road at former NSRR ROW	☑	☑	☑	☑
2. Witchduck Road at former NSRR ROW	☑	☑	☑	☑
3. Independence Boulevard at former NSRR ROW	☑	☑	☑	☑
4. Constitution Drive at former NSRR ROW	☑	☑	☑	☑
5. Rosemont Road at former NSRR ROW		☑	☑	☑
6. North Plaza Trail at former NSRR ROW			☑	☑
7. North Lynnhaven Road at former NSRR ROW			☑	☑
8. Lynnhaven Parkway at former NSRR ROW			☑	☑
9. London Bridge Road at former NSRR ROW			☑	☑[1]
10. Oceana Boulevard at former NSRR ROW			☑	
11. Great Neck Road (at Virginia Beach Boulevard)				☑
12. First Colonial Road (at Laskin Road)				☑
13. Birdneck Road (at Laskin Road)				☑

Source: Fitzgerald & Halliday, Inc. 2014

[1] The crossing will be utilized for vehicle maintenance only under this alternative and will not meet the criteria for a grade separation analysis as applied in this assessment.

Figure 5-1| Major Grade Crossings Evaluated



Source: Fitzgerald & Halliday, Inc., 2014

5.1 Methodology

The methodology for the grade crossing separation analysis is based on procedures presented by the Institute of Transportation Engineers (ITE)[2] and is based on criteria for evaluating operational, safety, institutional, and financial issues. As shown in **Figure 5-1**, the ITE methodology consists of three phases:

- Phase I: Initial Screening
- Phase II: Detailed Analysis
- Phase III: Verification

The initial screening (Phase I) results in one of three outcomes for each crossing: *"At-Grade Operation Should Be Feasible"*, *"Possible At-Grade Operation"* and *"Grade Separation Usually Required*". For all crossings initially screened as "*Possible At-Grade Operation*" and "*Grade Separation Usually Required"*, an engineering study is required as part of the detailed analysis to determine the operational and safety needs.

The detailed analysis (Phase II) results in a preliminary disposition of "*At-Grade"* or "*Grade Separated"* and identifies the level of traffic control measures needed for each crossing.

The methodology used for the grade crossing separation analysis is intended to be a general guideline and not a specific standard or regulation. Through engineering judgment, there may be opportunities in which a grade separation can be avoided even with high levels of traffic interference, as well as other situations in which a grade separation will be highly desirable even if the quantitative threshold is not met.

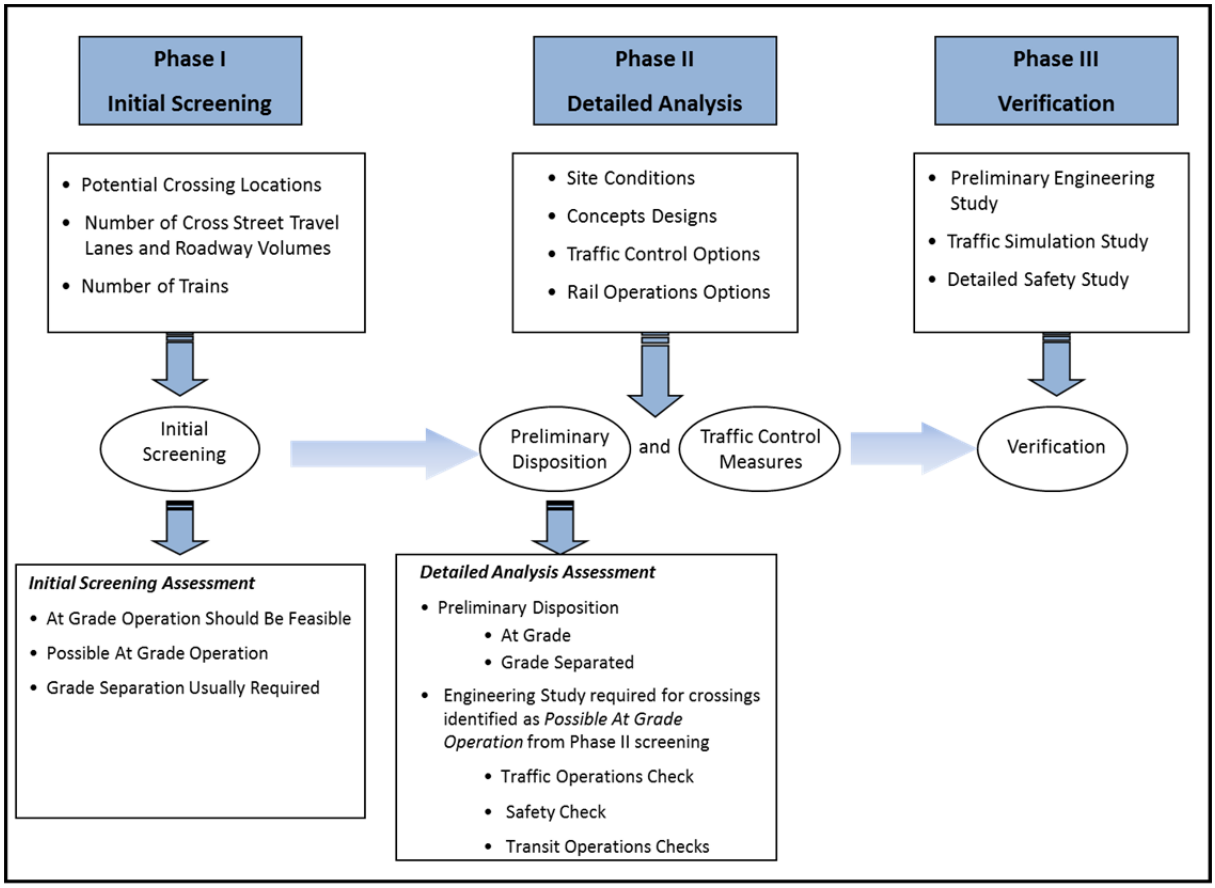
The following assumptions were considered for this analysis:

- It is assumed that the LRT and BRT systems will have similar operations (frequency and speed) along a fixed guideway alignment.
- The proposed transit system (LRT or BRT) will be a "low speed" system with an operating speed of less than 60 miles per hour (mph).
- The frequency of service will be 10 minute headways during the morning and afternoon peak hours, resulting in 6 transit vehicles (train sets or buses) per peak hour in each direction (total of 12 transit vehicles per peak hour).
- Train control (for LRT alternatives) or bus control (for BRT alternatives) at currently signalized at-grade crossings would require automated crossing gates. These gates would pre-empt (alter) the normal red-yellow-green cycle of the intersection to give priority to the passing transit vehicle. This is the most conservative approach to vehicle operations and shows the highest level of

[2] ITE Technical Committee 6A-42, Light Rail Transit Grade Separation Guidelines, Institute of Transportation Engineers, Washington, D.C., March 1992.

potential impacts. Traffic crossing the tracks/busway would be stopped while traffic parallel to the tracks/busway would be allowed to continue. It is anticipated that the operation of the crossing gates would be approximately 35 seconds. These operating assumptions will be revisited during later phases of design as part of the engineering analysis of each crossing.

Figure 5-2| Grade Crossing Separation Analysis Methodology



Source: Light Rail Transit Grade Separation Guidelines, Institute of Transportation Engineers, Washington, D.C., March 1992.

5.2 Phase I: Initial Screening

The initial screening is a planning-level assessment of crossings based on available traffic and geometric information. Conceptual designs are not needed for the initial screening. Planning information considered includes the following:

- A listing of all potential crossings
- Number of cross street travel lanes and peak hour roadway volume
- Number of vehicles (LRT or BRT) per peak hour or vehicle frequencies based on comparable lines

5.2.1 Input Data - Initial Screening

Existing and future traffic volumes developed as part of the VBTES were utilized for this analysis. The future roadway volumes were divided by the number of lanes on the roadway to determine the future peak vehicles per hour per lane (vphpl).

Service frequency data was obtained from the operations planning tasks of the VBTES. It is anticipated that the vehicle frequency will be 10 minute headways during the morning and afternoon peak hours, resulting in six crossings per peak hour in each direction (total of 12 trains or buses per peak hour along the fixed guideway).

5.2.2 Results from the Initial Screening

In accordance with the nomograph provided in the *Institute of Transportation Engineers Informational Report, Light Rail Transit Grade Separation Guidelines 1992*, each roadway crossing was assessed according to the following types:

- At-Grade Operation Should Be Feasible
- Possible At-Grade Operation
- Grade Separation Usually Required

As shown in **Table 5-2** and in the **Appendix**, the results from the initial screening indicate 4 locations were assessed to be *"At-Grade Operation Should Be Feasible"* and the remaining 8 locations were assessed to be **"***Possible At-Grade Operation".* There were no crossings determined to be "Grade Separated" from the initial screening. The following conclusions were drawn based on the projected peak vehicles per hour per lane (vphpl) and anticipating 6 transit vehicles per peak hour in each direction:

- A crossing with less than 700 vphpl is assessed to be "At-Grade Operation Should Be Feasible"
- A crossing with peak hour volumes ranging from 700 vphpl to 1,200 vphpl is assessed to be "Possible At-Grade Operation"
- A crossing with more than 1,200 vphpl is assessed to be "Grade Separation Usually Required"

Table 5-2| Initial Screening Results

Roadway Crossing/Transit Intersection	Traffic Data Location	2013 Peak Hour Volume per Lane (vphpl)	2034 Peak Hour Volume per Lane (vphpl)	Phase I Initial Screening Results
Princess Anne Road*	From Newtown Road to Cheyenne Road	715	895	Possible At-Grade Operation
Witchduck Road*	From I-264 to Virginia Beach Boulevard	1,050	875**	Possible At-Grade Operation
Independence Boulevard*	From Columbus Street to I-264	785	980	Possible At-Grade Operation
Constitution Drive*	From Virginia Beach Boulevard to Columbus Street	190	240	At-Grade Operation Should be Feasible
Rosemont Road	From Virginia Beach Boulevard to Bonney Road	465	580	At-Grade Operation Should be Feasible
North Plaza Trail	From Virginia Beach Boulevard to I-264	405	1,010	Possible At-Grade Operation
North Lynnhaven Road	From Virginia Beach Boulevard to Southern Boulevard	575	715	At-Grade Operation Should be Feasible
Lynnhaven Parkway*	From Virginia Beach Boulevard to I-264 WB Off-Ramp	495	615	At-Grade Operation Should be Feasible
London Bridge Road*	From Potters Road To Virginia Beach Boulevard	555	695	Possible At-Grade Operation
Oceana Boulevard	From Harpers Road to Virginia Beach Boulevard	770	960	Possible At-Grade Operation
Great Neck Road (at Virginia Beach Boulevard)*	From Virginia Beach Boulevard to Wolfsnare Road	755	945	Possible At-Grade Operation
First Colonial Road (at Laskin Road)*	Laskin Road to Virginia Beach Boulevard	750	940	Possible At-Grade Operation
Birdneck Road (at Laskin Road)*	I-264 to Virginia Beach Boulevard	600	750	Possible At-Grade Operation

Source: Fitzgerald & Halliday, Inc. and City of Virginia Beach, 2013

**Traffic volume data was obtained from the City of Virginia Beach Traffic Count Database System.*

***Projected volume reflects the Virginia Department of Transportation's Witchduck Road widening project which decreases the volume per lane.*

5.3 Phase II: Detailed Analysis

A detailed operational evaluation was conducted using available planning information and also information from the conceptual design plans that identify the geometric and traffic operational conditions at the proposed crossings.

The information considered for this analysis includes:

- ***Site Conditions***: Geometric/traffic operational conditions such as lane configuration including the nearest signalized intersection or major intersection on either side of the crossing as well as driveways, curb delineation, channelization or any other features affecting traffic operation in the vicinity of the crossing
- ***Concept Designs:*** Number of tracks, track alignment, and whether the crossing will be mid-block or will it intersect with the cross street at the crossing
- ***Traffic Control Options***: Automated crossing gates or operation with a traffic signal, as well as warning or safety devices; also whether a gated crossing will require preemption of traffic signals within the influence zone (an area of 200 feet or more where queuing could occur into the grade crossing)
- ***Transit Operations Options:*** Speed profile, station dwell and locations of "hold points" if the ability to accept transit vehicle delays is necessary

5.3.1 Preliminary Disposition

First, an assessment of "At-Grade", "Possible At-Grade Operation" or "Grade Separated" was determined based on the initial screening results, proposed transit operations, and a general assessment of safety conditions **(Table 5-2)**. The evaluation criteria are summarized below:

- If the initial screening indicates that "At-Grade Operation Should Be Feasible" and the crossing is proposed to be a "low speed" (<60 miles per hour) crossing controlled by a transit crossing signal and there are no salient safety issues, the preliminary disposition for Phase II would be "At-Grade". If there are safety issues, treat as "Possible At-Grade Operation".
- If the initial screening indicates "Possible At-Grade Operation", an engineering study of operational and safety issues is required. The engineering study is a multi-step evaluation of the level of service (LOS), queuing, and safety issues at adjacent intersections. The engineering study also considers the impacts to transit operations.
- If the initial screening indicates "Grade Separation Usually Required" and there is no transit crossing signal controlling the crossing and if unimpeded, "high speed" (> 60 miles per hour) transit operations are required, the result is "Grade Separated". If there is a transit crossing signal or the crossing is designated low speed for transit crossings, treat as "Possible At-Grade Operation".

A summary of the assessment results from these criteria, shown in **Table 5-3**, indicates two crossing locations along the former NSRR ROW to be *"At-Grade"* crossings based on the Phase II screening. No salient safety issues were identified from field observations and these locations were proposed to be a "low speed" (< 60 miles per hour) crossing controlled by a transit signal. These locations are:

- Constitution Drive
- North Lynnhaven Road

The crossings of Rosemont Road and Lynnhaven Parkway along the former NSRR ROW were identified as "At-Grade Operation Should be Feasible" under Phase I. However, each of these roadways also intersects I-264 within a relatively short distance of their at-grade crossings with the proposed transit system. It is anticipated that preemptively closing either roadway to allow the transit vehicles to pass could, at certain high traffic periods, back up traffic onto the I-264 interchanges. Therefore, the crossings of Rosemont Road and Lynnhaven Parkway are identified as *"Possible At-Grade Operation"* under the preliminary Phase II disposition, along with the remaining locations.

Table 5-3| Preliminary Phase II Disposition Results for 2034 Conditions

	Roadway Crossing/Transit Intersection	Phase I: Initial Screening Results	Preliminary Phase II Disposition Results
1	Princess Anne Road	Possible At-Grade Operation	Possible At-Grade Operation
2	Witchduck Road	Possible At-Grade Operation	Possible At-Grade Operation
3	Independence Boulevard	Possible At-Grade Operation	Possible At-Grade Operation
4	Constitution Drive	At-Grade Operation Should be Feasible	At-Grade
5	Rosemont Road	At-Grade Operation Should be Feasible	Possible At-Grade Operation
6	North Plaza Trail	Possible At-Grade Operation	Possible At-Grade Operation
7	N. Lynnhaven Road	At-Grade Operation Should be Feasible	At-Grade
8	Lynnhaven Parkway	At-Grade Operation Should be Feasible	Possible At-Grade Operation
9	London Bridge Road	Possible At-Grade Operation	Possible At-Grade Operation
10	Oceana Boulevard	Possible At-Grade Operation	Possible At-Grade Operation
11	Great Neck Road	Possible At-Grade Operation	Possible At-Grade Operation
12	First Colonial Road	Possible At-Grade Operation	Possible At-Grade Operation
13	Birdneck Road	Possible At-Grade Operation	Possible At-Grade Operation

Source: Fitzgerald & Halliday, Inc., 2013

5.3.2 Detailed Engineering Study

Following the Preliminary Phase II disposition, an engineering study was conducted to evaluate operational conditions of the 11 remaining proposed grade crossings identified as "*Possible At-Grade Operation*". The engineering study entailed a multi-step evaluation which is summarized below:

- ***Identify operational volumes:*** Review traffic volume assumptions and make adjustments as needed.
- ***Compute influence zone queue***: The influence zone queue is measured from an adjacent signalized intersection along the cross street towards the grade crossing.
- ***Compute crossing spillback queue***: The crossing spillback queue is measured from the grade crossing towards an adjacent roadway-roadway intersection.
- ***Evaluate Cross Street Queues vs. Available Storage***: Determine if mitigation measures are needed to address cross street queue impacts at the adjacent major intersection or if the adjacent major intersection creates an influence zone queue which impacts grade crossing.
- ***Evaluate Impact of Preemption on Cross-Street Progression***: Verify the ability of the roadway to recover from preemption events using the criteria established for the volume to capacity ratio of the adjacent signalized intersection. The preemption will allow the signal system to give priority to the transit system through the intersection over traffic flow so that the system can remain on schedule.
- ***Compute Controlling Intersection Level of Service***: The controlling intersection is the cross street signalized intersection at the grade crossing or within the influence zone.

A detailed safety review will be conducted for crossings when the decision to grade separate is indeterminate in order to determine whether adverse safety conditions, in conjunction with adverse operational conditions, would suggest a grade-separated solution.

Operational data under the No Build Alternative was utilized for the engineering study. The engineering study's findings include:

- Operation of the transit system at grade along the former NSRR ROW at Princess Anne Road, Witchduck Road, Independence Boulevard, Rosemont Road, North Plaza Trail, London Bridge Road, and First Colonial Road (at Laskin Road) will adversely affect the level of service[3] (LOS) at adjacent signalized intersections. Review of the operational data indicate that adjacent signalized intersections to the above crossings will operate with a volume to capacity ratio greater than 1.0 or operate with an unacceptable (LOS) E or LOS F under 2034 conditions.

[3] A level of service is a letter designation describing a range of operating conditions. There are six levels of service, from A to F, with LOS F representing the worst conditions.

- Traffic backups at adjacent signalized intersections will block the transit guideway crossing at Witchduck Road, Independence Boulevard, Rosemont Road, London Bridge Road, Oceana Boulevard, and First Colonial Road. Queue lengths[4] are anticipated to impact the grade crossing's influence zone which will result in vehicle queuing over the transit guideway. Additionally, traffic operations adjacent to proposed crossings are not anticipated to recover from preemption events which halt normal traffic flow to allow the transit system to operate.

The operational factors for 2034 are summarized in **Table 5-4**.

[4] The 95th percentile queues were reported and represent the maximum back of queue (number of vehicles that are queued based on arrival patterns of vehicles and vehicles that do not clear the intersection during a given green phase) with 95th percentile traffic volumes.

Table 5-4| Summary of Operational Factors for 2034 Conditions

Crossing Location	Princess Anne Road	Witchduck Road	Independence Boulevard	Rosemont Road	North Plaza Trail
Adjacent Signalized Intersection	**Newtown Road**	**Cleveland Street**	**Columbus Street**	**Virginia Beach Boulevard**	**Virginia Beach Boulevard**
Intersection Operational volumes (approach volume in influence zone)	962 vph	1,878 vph	3,614 vph	1,992 vph	799
Influence Zone Queue (adjacent intersection to Crossing)	870 feet	610 feet	250 feet	270 feet	700 feet
Cross Street Queues (influence zone)	228 feet	640 feet	940 feet	751 feet	412 feet
Impact to Cross Street Queues	No	Yes	Yes	Yes	No
Intersection LOS	F	D	F	F	E
Impact of Pre-emption on Cross Street Progression	Fail	Fail	Fail	Fail	Fail
Worst Case Volume to Capacity Ratio (V/C) using HCM 2000 Methdologies	1.35	1.04	1.30	1.28	1.20

Source: Fitzgerald & Halliday, Inc., 2013
vph: vehicles per hour
Yes: Queues extend over the fixed-guideway
No: Queues do not extend over the fixed-guideway
Fail: V/C is greater than or equal to 1.0
Marginal: V/C is between 0.90 and 1.0
OK: V/C is less than or equal to 0.90

Crossing Location	Lynnhaven Parkway	London Bridge Road	Oceana Boulevard	Great Neck Road	First Colonial Road	Birdneck Road
Adjacent Signalized Intersection	**S. Lynnhaven Road**	**Virginia Beach Boulevard**	**S. First Colonial Road**	**Old Great Neck Road**	**Laurel Lane/Republic Road**	**24th Street**
Intersection Operational volumes (approach volume in influence zone)	1,224 vph	2,015 vph	1,985 vph	Not Available	1,917 vph	1,414 vph
Influence Zone Queue (adjacent intersection to Crossing)	600 feet	1,000 feet	1,150 feet	Not Applicable	875 feet	840 feet
Cross Street Queues (influence zone)	230 feet	1,020 feet	1,176 feet	Not Available	978 feet	222 feet
Impact to Cross Street Queues	No	Yes	Yes	No	Yes	No
Intersection LOS	D	F	C	Not Available	D	B
Impact of Pre-emption on Cross Street Progression	Marginal	Fail	Marginal	Ok	Fail	Ok
Worst Case Volume to Capacity Ratio (V/C) using HCM 2000 Methdologies	0.99	1.32	0.93	Not Available	1.12	0.62

Source: Fitzgerald & Halliday, Inc., 2013
vph: vehicles per hour
Yes: Queues extend over the fixed-guideway
No: Queues do not extend over the fixed-guideway
Fail: V/C is greater than or equal to 1.0
Marginal: V/C is between 0.90 and 1.0
OK: V/C is less than or equal to 0.90

The crossing locations were evaluated to determine whether each crossing would pass or fail the *Traffic Operations Check* based on the operational factors and traffic impacts determined during the engineering study. Proposed crossings pass or fail the traffic operations test based on the following:

- Pass = No operational factors that would result in unacceptable traffic impacts due to the proposed grade crossing.
- Fail = Unacceptable conditions based on the traffic operational analysis.

Crossings that fail the test receive a preliminary disposition of *"Grade Separated"*; otherwise, safety and transit operations tests were evaluated to determine the preliminary disposition. Six of the eleven proposed crossing locations evaluated in the engineering study failed the traffic operations test. These locations are:

1. Witchduck Road
2. Independence Boulevard
3. Rosemont Road
4. London Bridge Road
5. Oceana Boulevard
6. First Colonial Road

It is anticipated that an at-grade fixed guideway transit crossing at these locations will have impacts to traffic operations that would result in unacceptable traffic impacts. It is anticipated that these locations will result in queues from adjacent signalized intersections which would extend over the fixed guideway. Therefore, these locations fail the Traffic Operations Check resulting in a preliminary disposition of "*Grade Separated*".

The proposed grade crossings of the former NSRR ROW at Princess Anne Road, North Plaza Trail, Lynnhaven Parkway, Great Neck Road, and Birdneck Road (Laskin Road) were determined to pass the Traffic Operations Check. Therefore, these proposed crossings were evaluated against Safety and Transit Operations. The criteria for these tests are:

Safety Check

- Pass = Safety concerns are minor and/or can be mitigated.
- Fail = Mitigation measures are not available to address safety concerns to an adequate level.

Transit Operations Check

- Pass = Impact of the signal control assumptions and speed used in the traffic operations check are acceptable to the transit operating plan and the patronage assumptions.
- Fail = Unacceptable impacts of the signal control assumptions and speed used in the traffic operations check

Based on professional judgment and general knowledge of traffic circulation and geometric conditions in the area, it is anticipated that the proposed crossings at Princess Anne Road, North Plaza Trail, and Birdneck Road can operate at-grade and:

- Will not have safety concerns that cannot be mitigated, and
- Will not have signal control measures and roadway speed that are not acceptable to the transit operating plan and the patronage assumptions.

Therefore, these proposed crossings were assessed to pass all three basis tests (Traffic Operations, Safety, and Transit Operations) and were determined to have a preliminary disposition of "At-Grade", meaning an at-grade intersection will not have unacceptable impacts.

At Lynnhaven Parkway, traffic operations at the adjacent signalized intersection (Lynnhaven Road) to the proposed grade crossing would operate at an acceptable level (LOS D) and the queues will not impact the grade crossing's influence zone. Traffic at this location is anticipated to marginally recover from preemption events. However, it is anticipated that the queue length from a preemption event will negatively impact traffic operations on the I-264 westbound off-ramp. Therefore, the proposed crossing at Lynnhaven Parkway was determined to have a preliminary disposition of "Grade Separated".

At Great Neck Road, traffic operations at its intersection with Virginia Beach Boulevard would operate at an unacceptable level (LOS F) under future conditions in 2034. Though operations at the adjacent signalized intersection is anticipated to operate an acceptable level (LOS D or better), operations on Virginia Beach Boulevard would result in unacceptable impacts with the signal control assumptions resulting from the transit system operating at-grade. Therefore, the proposed crossing at Great Neck Road was determined to have a preliminary disposition of "Grade Separated".

Further analysis will be required for some of these intersections to ensure any transit overpass meets Federal Aviation Administration (FAA) safety criteria. FAA regulations impose height restrictions on structures near the end of a public or military airfield where at least one runway is greater than 3,200 feet, such as at the Naval Air Station (NAS) Oceana airfield. FAA requires any construction or alteration within 20,000 feet of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with at least one runway more than 3,200 feet to be approved by FAA. The height clearance criteria rise with distance from the end of the runway, and therefore intersections farther from the NAS Oceana runways are less likely to be affected. **Figure 5-3** shows distance and estimated FAA height clearance requirements for the 6 major intersections where a preliminary disposition of "Grade Separated" has been determined. Assuming that it would be the transit fixed guideway traveling over the existing roadway, a typical structure height of approximately 45 feet (including the catenary system for a light rail transit mode) from roadway grade is anticipated.

The intersection of London Bridge Road and the former NSRR ROW is approximately 3,620 feet from the closest NAS Oceana runway with an elevation of approximately 15.5 feet above sea level, approximately 2 feet lower in elevation as the runway (elevations are based on available topographic data, provided in two foot contours). Projecting the FAA height criteria to the London Bridge Road intersection indicates an allowable height of around 34.2 feet. Therefore, a transit overpass over London Bridge Road would likely be subject to further review and approval through the FAA process. A final determination as to

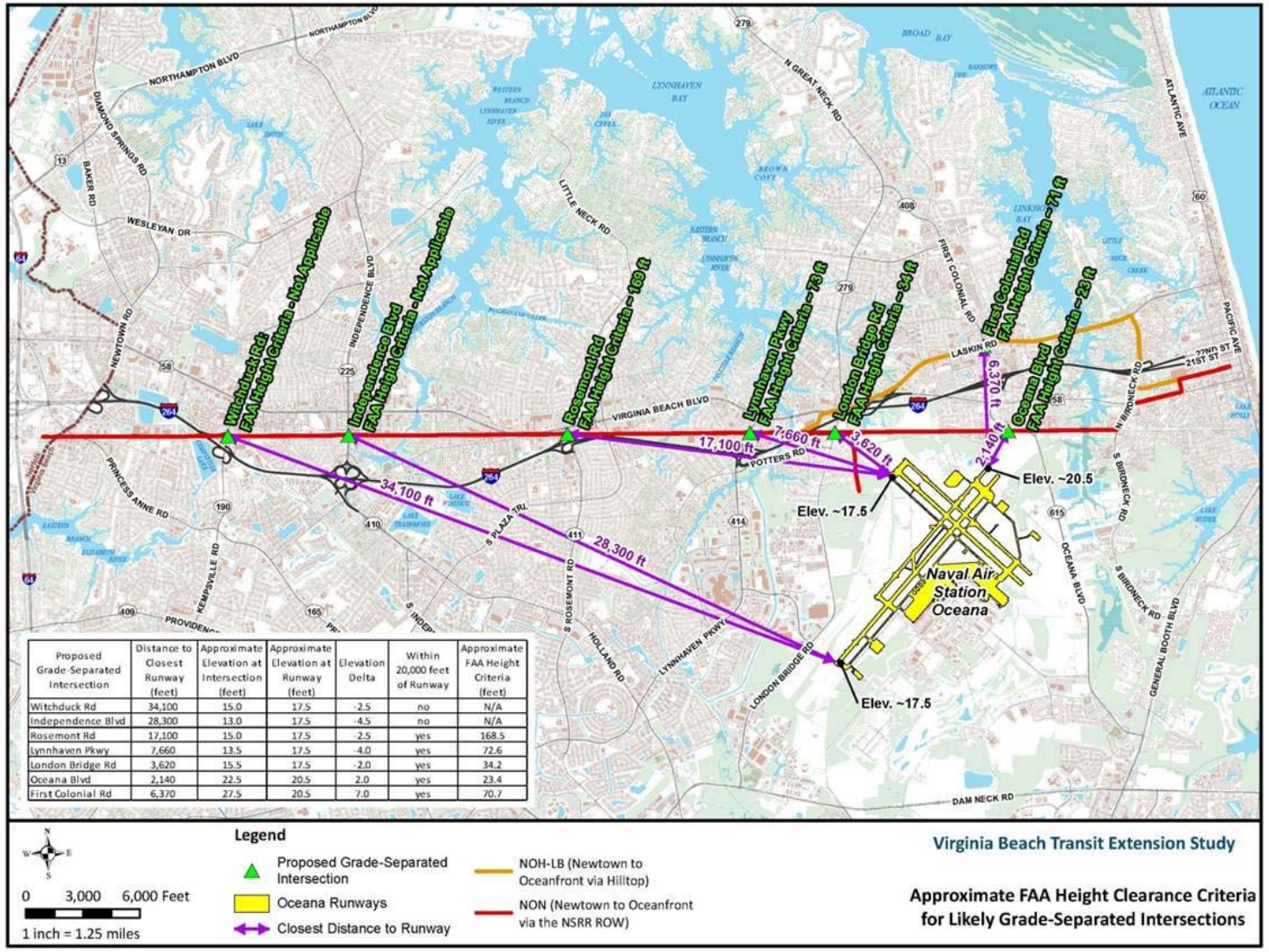
whether a FAA review is required would be made during final design when height of the overpass and existing roadway and runway elevations are determined with greater accuracy.

The intersection of Oceana Boulevard and the former NSRR ROW is approximately 2,140 feet from the closest NAS Oceana runway with an elevation of approximately 22.5 feet above sea level, approximately 2 feet higher in elevation than the closest runway (elevations are based on available topographic data, provided in two foot contours). Projecting the FAA height criteria to the Oceana Boulevard intersection indicates an allowable height of around 23.4 feet. Therefore, a transit overpass over Oceana Boulevard would likely be subject to further review and approval through the FAA process. A final determination as to whether a FAA review is required would be made during final design when height of the overpass and existing roadway and runway elevations are determined with greater accuracy.

Any grade-separation structure planned for Oceana Boulevard and London Bridge Road would need to be evaluated against the height restrictions applicable to NAS Oceana's runways. If the proposed height of the grade-separation structure exceeds the height clearance criteria set by FAA, then FAA form 7460-1 "Notice of Proposed Construction or Alteration" must be submitted for FAA review.

As shown in **Figure 5-3**, the other major intersections designated as Grade Separated are not likely to be affected by the FAA height clearance criteria. A summary of the results from the detailed analysis are provided in **Table 5-5**.

Figure 5-3| Height Clearance Requirements



Proposed Grade-Separated Intersection	Distance to Closest Runway (feet)	Approximate Elevation at Intersection (feet)	Approximate Elevation at Runway (feet)	Elevation Delta	Within 20,000 feet of Runway	Approximate FAA Height Criteria (feet)
Witchduck Rd	34,100	15.0	17.5	-2.5	no	N/A
Independence Blvd	28,300	13.0	17.5	-4.5	no	N/A
Rosemont Rd	17,100	15.0	17.5	-2.5	yes	168.5
Lynnhaven Pkwy	7,660	13.5	17.5	-4.0	yes	72.6
London Bridge Rd	3,620	15.5	17.5	-2.0	yes	34.2
Oceana Blvd	2,140	22.5	20.5	2.0	yes	23.4
First Colonial Rd	6,370	27.5	20.5	7.0	yes	70.7

Source: HDR Engineering, 2014

Table 5-5| Final Phase II Disposition Results for 2034 Conditions

	Roadway Crossing/Transit Intersection	Final Disposition Results
1	Princess Anne Road at former NSRR ROW	At-Grade
2	Witchduck Road at former NSRR ROW	Grade Separated
3	Independence Boulevard at former NSRR ROW	Grade Separated
4	Constitution Drive at former NSRR ROW	At-Grade
5	Rosemont Road at former NSRR ROW	Grade Separated
6	North Plaza Trail at former NSRR ROW	At-Grade
7	N. Lynnhaven Road at former NSRR ROW	At-Grade
8	Lynnhaven Parkway at former NSRR ROW	Grade Separated
9	London Bridge Road at former NSRR ROW	Grade Separated*
10	Oceana Boulevard at former NSRR ROW	Grade Separated*
11	Great Neck Road (at Virginia Beach Boulevard)	Grade Separated
12	First Colonial Road (at Laskin Road)	Grade Separated
13	Birdneck Road (at Laskin Road)	At-Grade

Source: Fitzgerald & Halliday, Inc., 2013

**Pending further evaluation of height of potential grade-separation structure in accordance with FAA height clearance criteria for NAS Oceana.*

5.4 Traffic Control Measures

Based on the information and conclusions of the detailed analysis, traffic control measures for the grade crossings will be needed for crossings that have been determined as "*At-Grade*" from this grade separation analysis. In addition, traffic control measures will be needed for the remaining crossings (all at-grade) not considered as major crossings for this evaluation.

The traffic control measures could consist of, but are not limited to:

- Automatic crossing gates
- Traffic signalization
- Traffic signal preemption
- Traffic signal coordination
- Supplemental active warning devices

Additionally, measures to address other issues relative to the conceptual design will be identified after its completion. Requirements for any supplemental studies will also be identified resulting from site-specific considerations or costs associated with grade separations. Such supplemental studies could include a preliminary engineering study, traffic simulation study, or detailed safety study. Results from supplemental studies could affect the crossing dispositions identified in this technical memorandum.

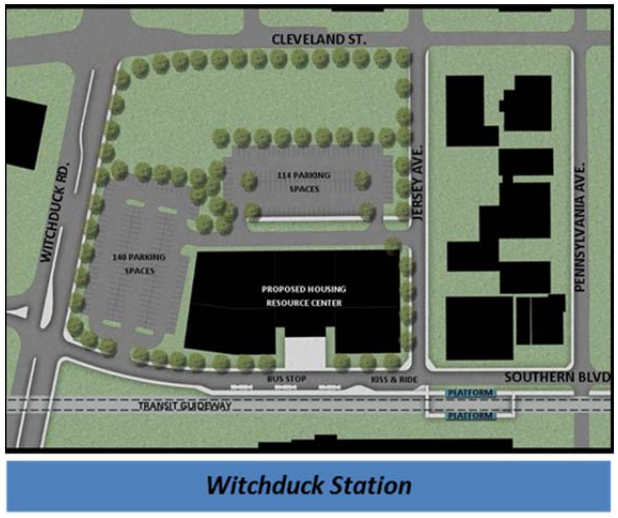
6.0 FUTURE BUILD CONDITIONS

The Build Alternative(s) represents the future traffic volumes, the future transportation network that includes the planned roadway improvements, and transportation conditions that support the transit alternative alignment(s). This chapter describes traffic operations and conditions for the Build LRT and BRT alternatives.

6.1 Build Alignments

The Build Alternatives consist of a set of different transit alignments and modes that meet the purpose and need of the project. Four alignment alternatives were studied, each with two different transit modes for a total of eight build alternatives. The alignments are described in greater detail below.

6.1.1 Alternative 1A: Town Center Alternative



Witchduck Station

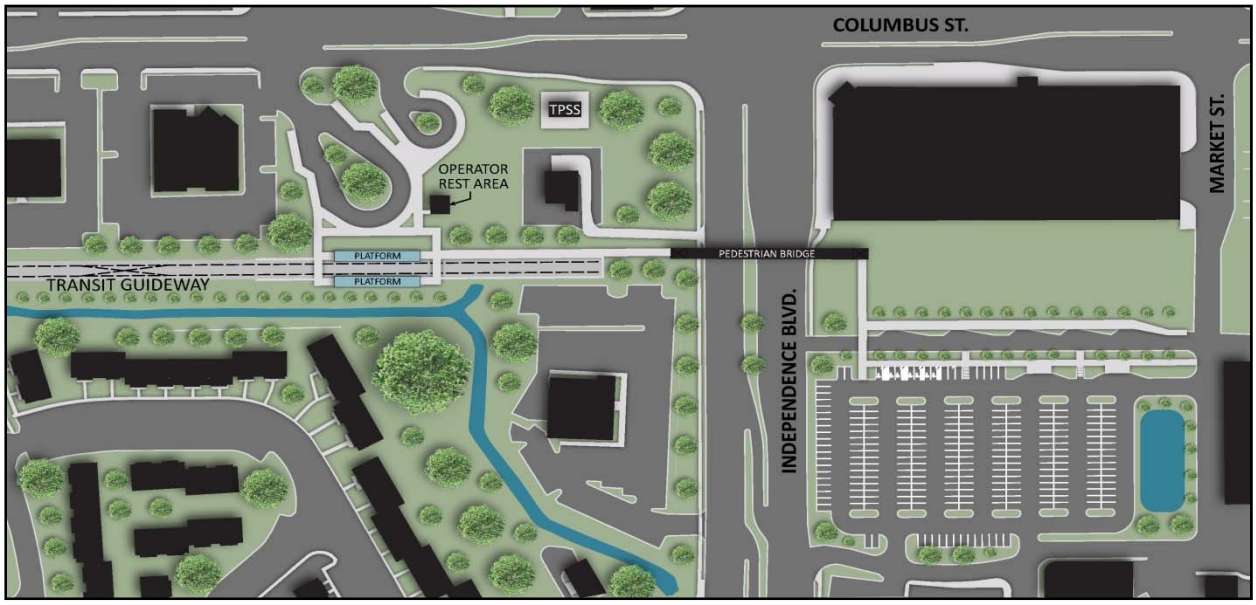
The Town Center Alternative would follow the former NSRR ROW from The Tide's Newtown Road Station to the proposed Town Center Station (See **Figure 6-1**) (approximately 3 miles).

A new eastbound station platform would be constructed at the Newtown Road Station, and the existing platform would serve the westbound direction. From the Newtown Road Station, this alignment alternative would travel east along the former NSRR ROW. The alignment would cross Newtown Road and Princess Anne Road at ground level (or "at-grade").

Continuing east, the alignment would cross Greenwich Road at-grade and pass under the existing I-264 bridge before rising on a new bridge (or "grade-separated" over Witchduck Road. A station with a Park & Ride and bus transfer area would be located east of Witchduck Road, adjacent to Southern Boulevard (see **Witchduck Station**). Continuing east, the alignment would cross Euclid Road and Kellam Road at-grade. In the vicinity of the Virginia Beach Town Center, various station sites are under consideration. For Alternative 1A, an end-of-line station with Park & Ride and bus loading area would be located at one of the following sites:

- At ground level and immediately west of Independence Boulevard with a pedestrian bridge over the Boulevard to connect to a park and ride on the east side of Independence Boulevard;
- On a new transit bridge starting east of Kellam Road over Independence Boulevard and Market Streets with the boarding platforms directly over Independence Boulevard;
- On a new transit bridge starting east of Kellam Road over Independence Boulevard and Market Streets with the boarding platforms directly over Market Street; or

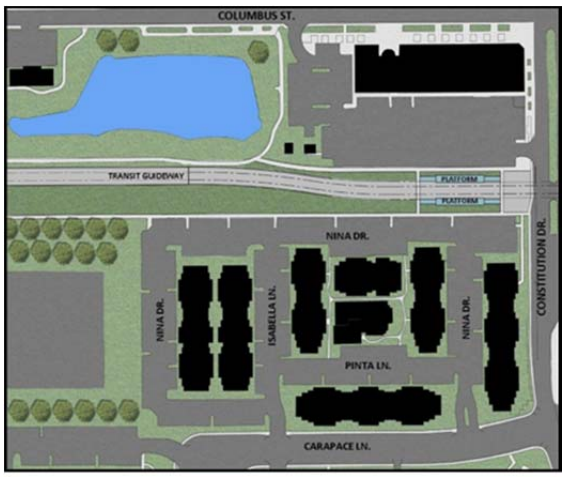
~ At ground level and immediately west of Constitution Drive (a new transit bridge would be required over Independence Boulevard and Market Street for this station site option). For this station location only, the alignment would end approximately 450 feet east of Constitution Drive to provide extra track for temporary vehicle storage (See **Town Center Station Options A-D**).



Town Center Station
A. West Option

Town Center Station
B. Independence Boulevard Option

Town Center Station
C. Market Street Option



Town Center Station
D. Constitution Drive Option

6.1.2 Alternative 1B: Rosemont Alternative

The Rosemont Alternative would follow the former NSRR ROW from The Tide's Newtown Road Station to the proposed Rosemont Station, west of Rosemont Road (See **Figure 6-1**) (approximately 4.8 miles). From Newtown Road to Kellam Road, this alignment is the same as Alternative 1A.

East of Kellam Road, the alignment would rise to be grade separated over Independence Boulevard and Market Street. For Alternative 1B, a station would be located at one of the following sites in the vicinity of Virginia Beach Town Center:

- On a new transit bridge over Independence Boulevard and Market Street with the boarding platforms directly over Independence Boulevard;
- On a new transit bridge over Independence Boulevard and Market Street with the boarding platforms directly over Market Street; or
- At ground level and immediately west of Constitution Drive. (See **Town Center Station Options B-D**).

From any of the Town Center Station options, the alignment would continue east across Constitution Drive at-grade. The alignment would cross Thalia Creek on a new two-track transit bridge. The alignment would continue east across Kentucky Avenue and Lynn Shores Drive at-grade before entering the **Rosemont Station**. The alignment would end approximately 400 feet east of the station leaving extra track for temporary vehicle storage.

Rosemont Station

6.1.3 Alternative 2: NSRR Alternative

The NSRR Alternative would follow the former NSRR ROW from The Tide's Newtown Road Station to the Virginia Beach Oceanfront Resort Area (See **Figure 6.1**) (approximately 12.2 miles). From Newtown Road to the Rosemont Station, this alignment is the same as Alternative 1B.

Extending east from the proposed Rosemont Station, the alignment would rise to be grade separated over Rosemont Road. The alignment would cross South Plaza Trail at-grade. Past South Plaza Trail, the alignment would cross North Lynnhaven Road at-grade before coming to a station with a Park & Ride lot along Southern Boulevard between North Lynnhaven Road and Lynnhaven Parkway (see **Lynnhaven Station**).

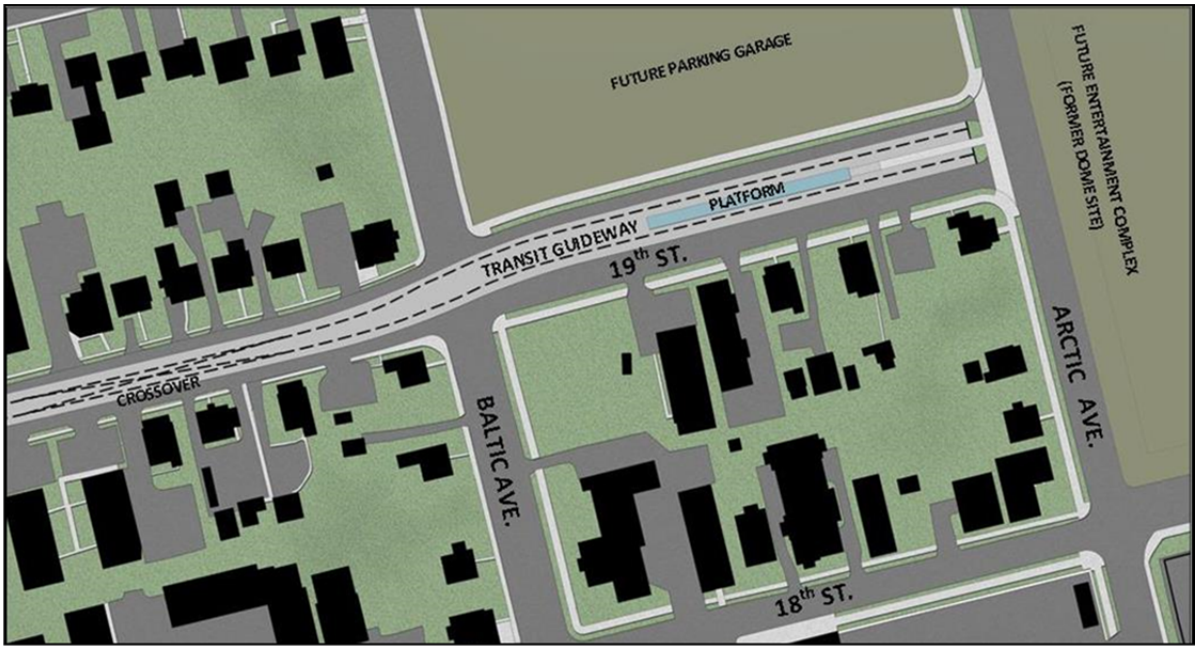
Lynnhaven Station

After exiting the Lynnhaven Station, the alignment would rise to be grade separated over Lynnhaven Parkway. The alignment would then cross London Bridge Creek on a new bridge and go under the existing I-264 overpass. After passing under I-264, Alternative 2 would rise to be grade separated over London Bridge Road. Continuing east from London Bridge Road, the alignment would continue along the former NRRR ROW immediately north of NAS Oceana. West of Air Station Drive would be a vehicle storage and maintenance facility and a station with a Park & Ride lot (See **North Oceana Station**). Continuing east from the station, the alignment would remain at-grade and cross Air Station Drive, South First Colonial Road, Oceana Boulevard, Sykes Avenue, and Distribution Drive.

North Oceana Station

At Birdneck Road, the alignment would turn off of the former NSRR ROW to the north into the median of Birdneck Road and then east adjacent to the north edge of 17th Street. At Washington Avenue, the alignment would turn north to pass through the parking lot at the Virginia Beach Convention Center. The **Convention Center Station (Alternative 2)** would be located immediately south of 19th Street. At 19th Street, the alignment would turn east into the median of 19th Street to the end-of-line **Oceanfront Station** at the intersection of 19th Street and Arctic Avenue.

Convention Center Station (Alternative 2)

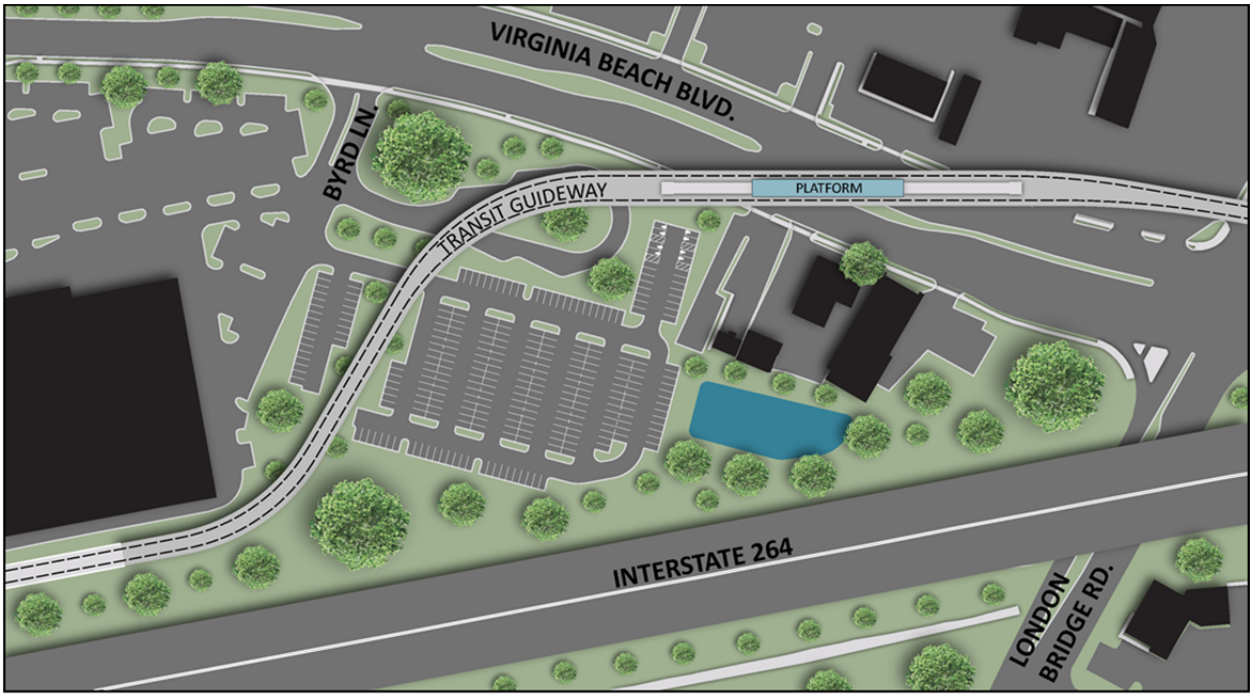


Oceanfront Station

6.1.4 Alternative 3: Hilltop Alternative

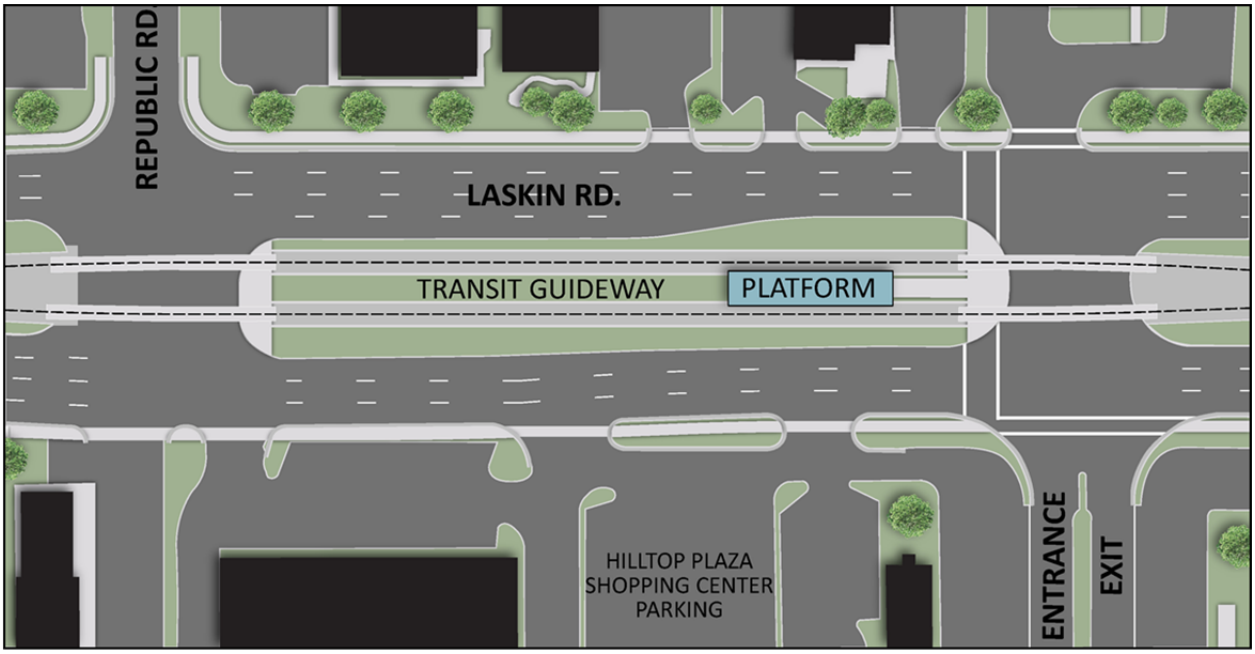
The Hilltop Alternative would follow the former NSRR ROW from The Tide's Newtown Road Station to London Bridge Creek and then Virginia Beach Boulevard, Laskin Road, and Birdneck Road to the Virginia Beach Oceanfront Resort Area (See **Figure 6-1**) (approximately 13.5 miles). From Newtown Road to London Bridge Creek, this alignment is the same as Alternative 2.

Just east of London Bridge Creek and west of the I-264 overpass, the alignment would leave the NSRR ROW onto its own alignment parallel to I-264. The alignment then turns northeast on a bridge that would cross above Virginia Beach Boulevard and Great Neck Road. The **Great Neck Station** would be located on the structure over Virginia Beach Boulevard west of Great Neck Road. The elevated alignment would continue north of Virginia Beach Boulevard/Laskin Road and would turn to cross over the westbound lanes of Laskin Road. The alignment, still on elevated structure, would continue south of the westbound lanes, over the I-264 on-ramp, and then touch down in the median of Laskin Road west of Phillip Avenue, where the eastbound and westbound lanes of Laskin Road converge.

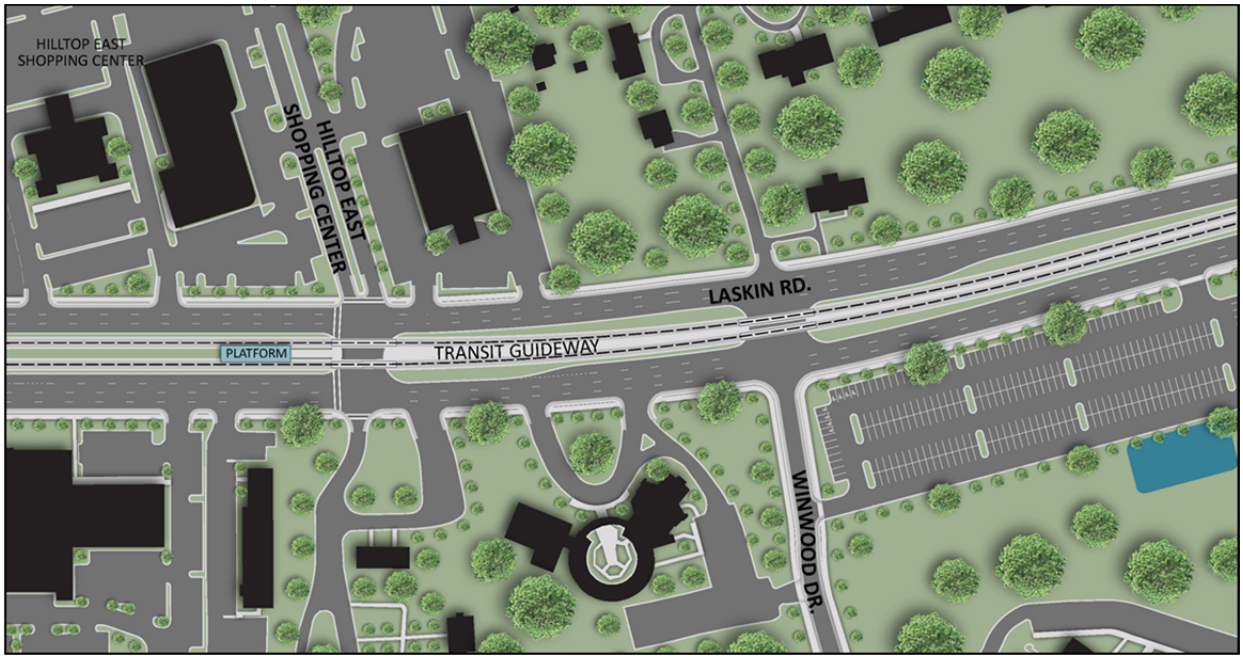


Great Neck Station

The alignment would continue in the median of Laskin Road. East of Republic Road would be a new walk-up station (see **Hilltop West Station**). The alignment would rise on a bridge east of Hilltop Plaza Shopping Center, just west of First Colonial Road. It would remain on structure over First Colonial Road and would touch down again in the median of Laskin Road near Nevan Road. The alignment would continue in the median of Laskin Road, and a new station would be located near the entrance to the Hilltop East Shopping Center (see **Hilltop East Station**).



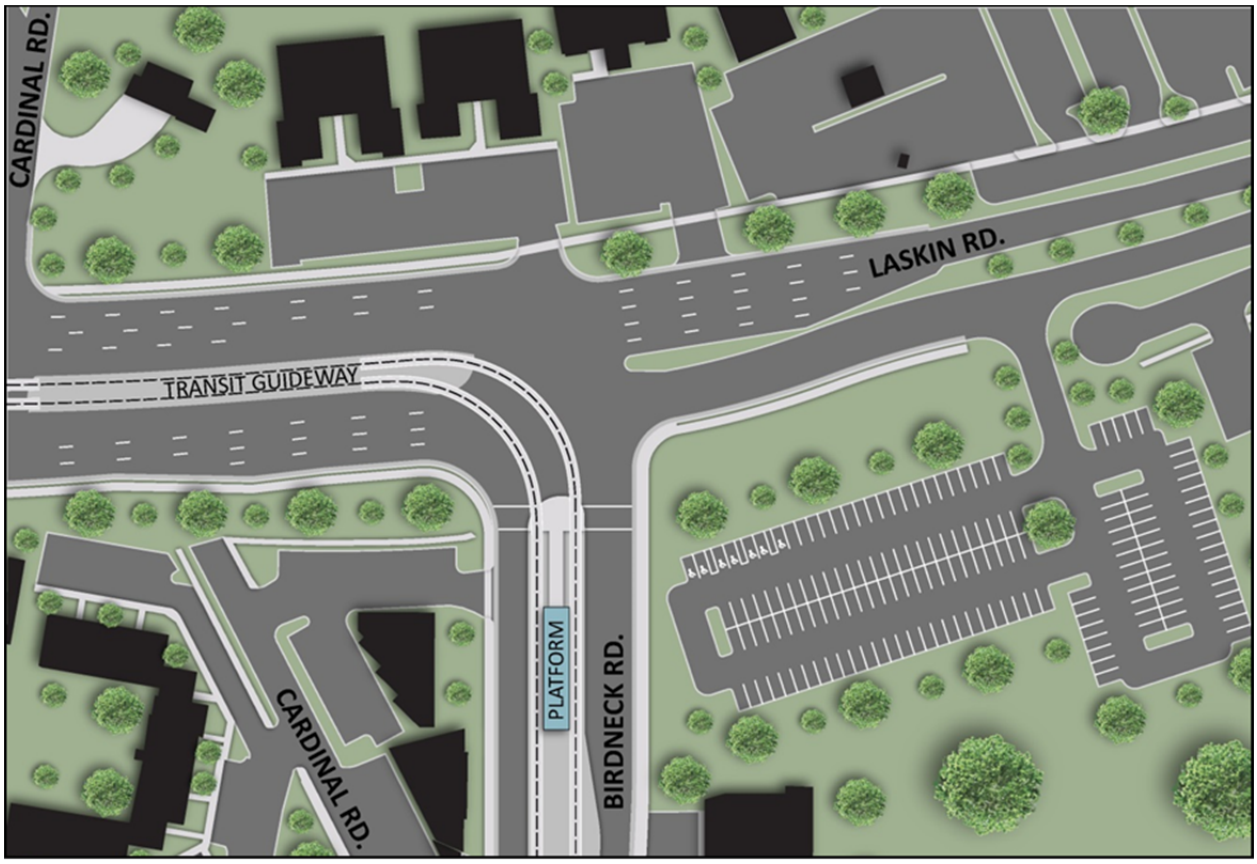
Hilltop West Station



Hilltop East Station

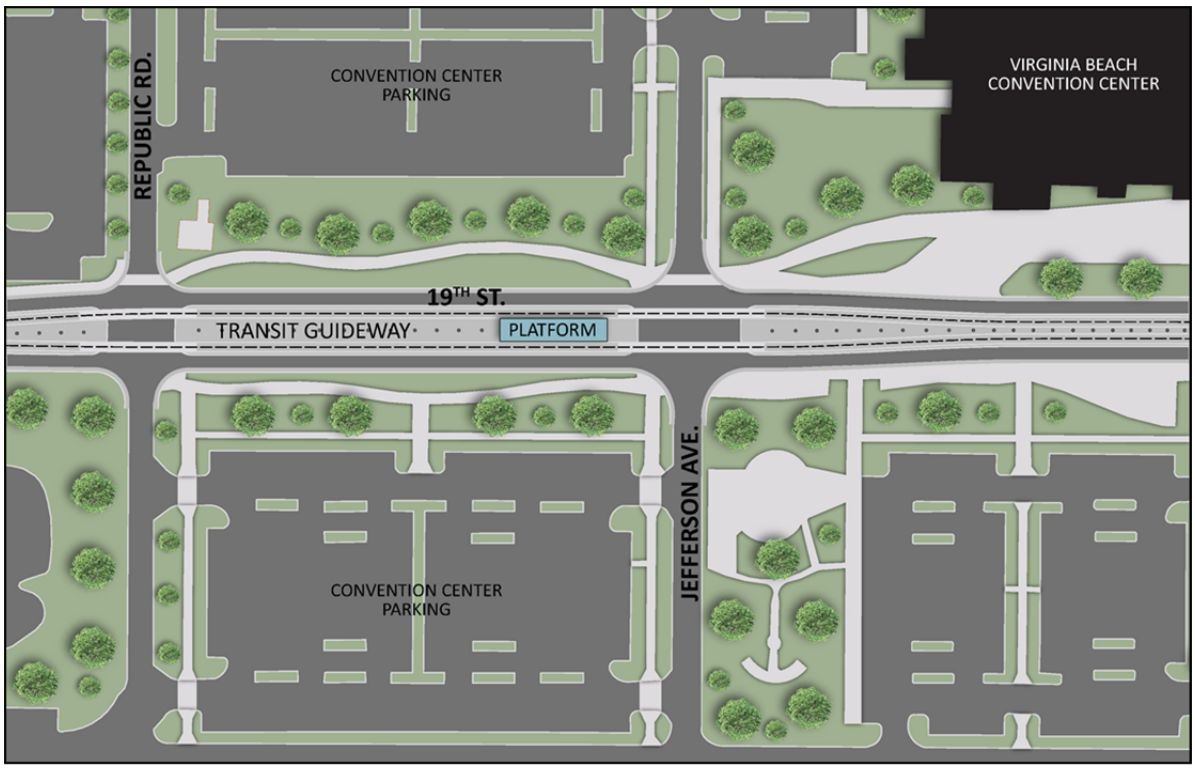
The alignment would continue east in the median of Laskin Road until it intersects with Birdneck Road. Here, the alignment would turn south onto the median of Birdneck Road. A station would be located in the median of Birdneck Road south of Laskin Road, and a Park & Ride lot would be located southeast of

the intersection of Laskin Road and Birdneck Road (see **Birdneck Station**). The alignment would continue in the median of Birdneck Road including under I-264 until it reaches 19th Street.



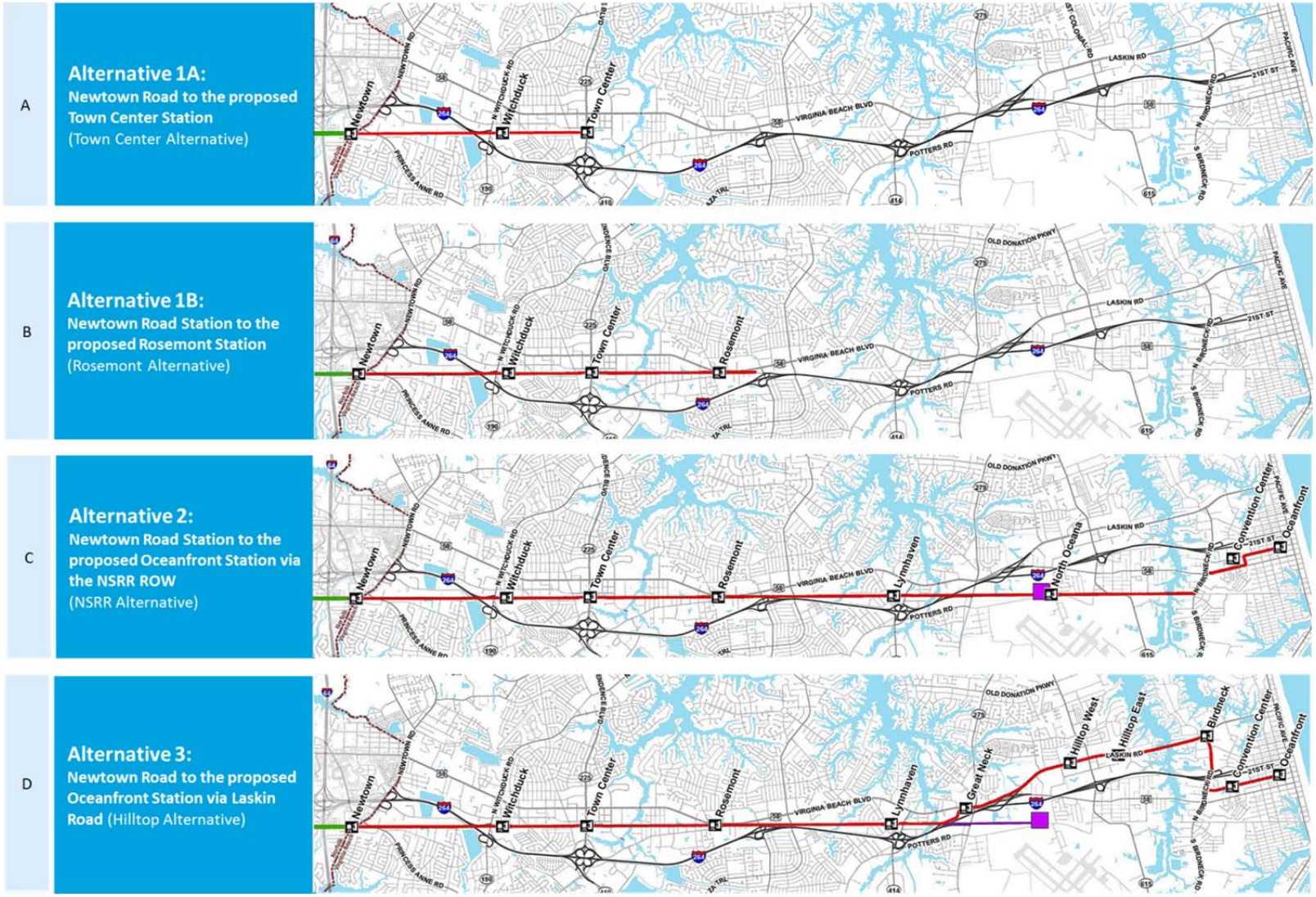
Birdneck Station

At 19th Street the alignment would turn east into a new median of 19th Street. West of Jefferson Avenue would be a station to serve the **Convention Center Station (Alternative 3)**. This station would use existing Convention Center parking lots when available. The alignment would continue in the median of 19th Street to its terminal station west of Arctic Avenue. (see **Oceanfront Station**).



Convention Center Station (Alternative 3)

Figure 6-1| Alignment Alternatives



Source: HDR Engineering, 2014

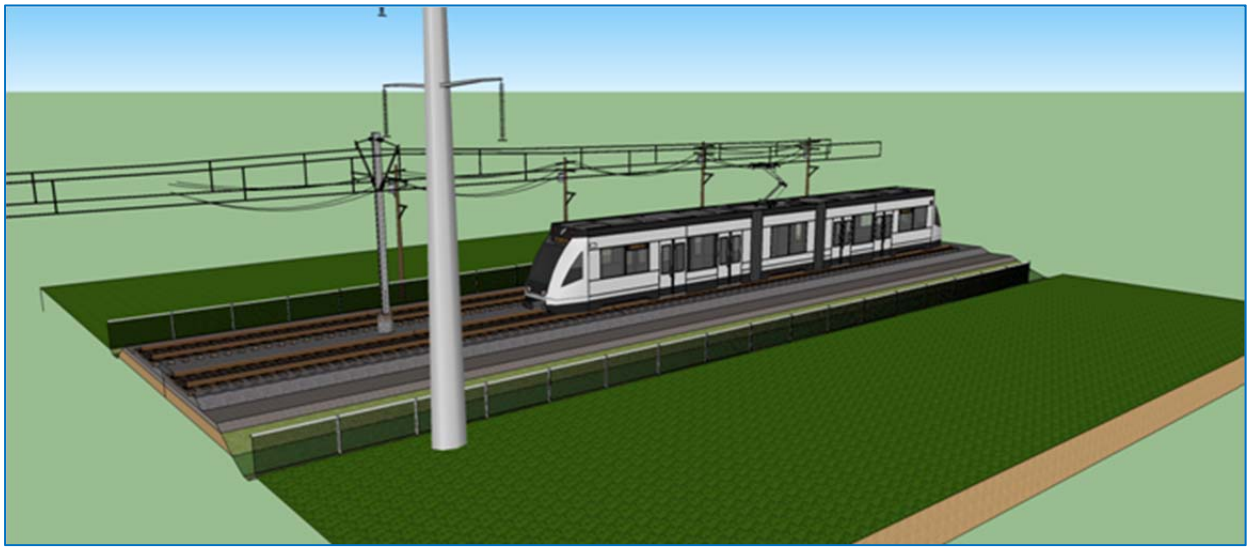
6.2 Transit Operating Characteristics

6.2.1 Light Rail Transit

The LRT guideway includes two tracks made of continuously welded steel rails. Each track is generally used for travel in a single direction, but crossover tracks are placed at regular intervals to allow trains to use the other track if necessary.

The primary types of track structures are ballasted (the rails are affixed to concrete or timber cross ties that are held in place by stone ballast), embedded in a concrete slab (such as a street-running segment of the alignment), or directly affixed to concrete using special fasteners (mostly used on bridges). For portions of the Build Alternatives along the former NSRR ROW, the LRT track section would be similar to that found on The Tide east of the Norfolk State University Station. This section consists of two ballasted tracks (**Figure 6-2**) and ditches on each side to drain water away from the ballast.

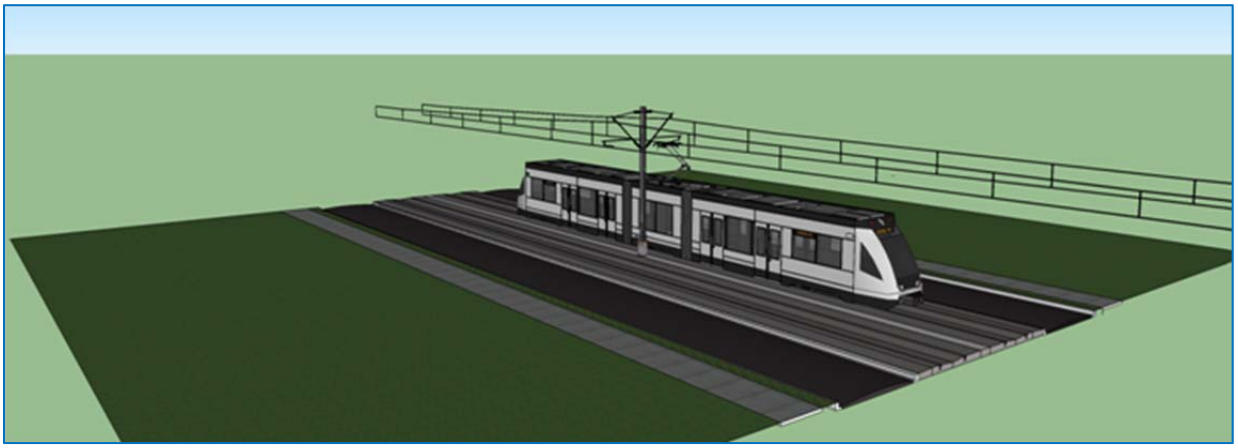
Figure 6-2| Ballasted Track Section (along former NSRR ROW)



Source: HDR Engineering, 2014

Embedded tracks (**Figure 6-3**) would be used in low-speed areas where an open style of track (such as ballast) is not desired. Embedded track is proposed to be used along Birdneck Road in the Hilltop Alternative and 19th Street in the NSRR Alternative and Hilltop Alternative. Shared lanes with LRT and rubber-tired vehicles are not proposed under any of the LRT alternatives. Where embedded tracks are proposed, the LRT guideway would be delineated using pavement markings, curbs, or other physical devices.

Figure 6-3|Embedded Track Section (Birdneck Road and 19th Street)



Source: HDR Engineering, 2014

All of the LRT alternatives would utilize the same type of vehicle that is used for HRT's existing light rail service (see **Figure 6-4**). Currently HRT uses the Siemens S70 light rail vehicle (LRV). The LRT alternatives would be an extension of The Tide, and vehicles from the existing fleet, along with any new vehicles, would be used to provide service for the entire system in Norfolk and Virginia Beach.

Figure 6-4| Light Rail Vehicle

Source: HDR Engineering, 2014

The methods of controlling traffic at light rail crossings will vary depending on the crossing location. Where LRT alignments will cross public streets at-grade, devices such as railroad-style flashing lights, gates, and conventional traffic signals will be used to control traffic. In low-speed areas and where the LRT will operate in the median of a roadway, traffic signals will be used for controlling both LRT and road vehicles, sometimes in conjunction with flashing lights and gates.

In areas where the LRT will operate at high speeds, such as on the former NSRR ROW, light rail vehicles will be controlled using train signals and monitored from an operations control center. The train control system includes circuits on the tracks, signal and power cables, and wayside signal bungalows. Signal bungalows are small sheds that contain equipment used to operate the train control system. They need to be placed near special trackwork such as turnouts and crossovers, and elsewhere along the track

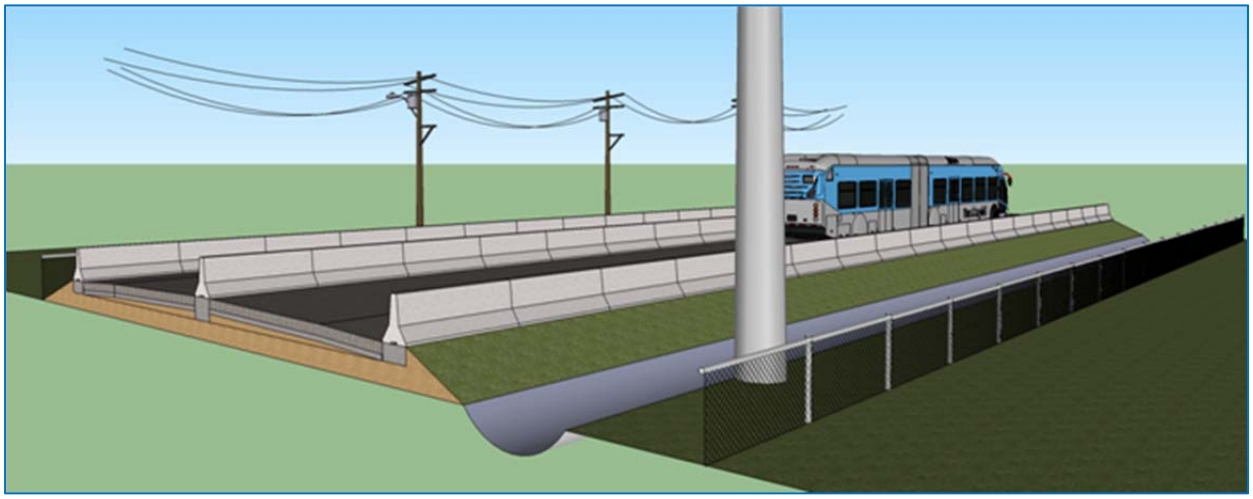
alignment depending on the signal system's design. The signal bungalow locations have not been identified at this stage of the project.

All warning devices, traffic signals, signs, and pavement markings will be in conformance with the current version of the *Manual on Uniform Traffic Control Devices* (MUTCD). Modifications to the existing roadway network to construct and operate the transit service will be in conformance with the current version of the VDOT Road Design Manual (2005), to be used in conjunction with specifications, standards, policy directives (State and Federal) and design policy manuals published by the American Association of State Highway and Transportation Officials (AASHTO).

6.2.2 Bus Rapid Transit

Where the BRT will operate in an exclusive or semi-exclusive guideway, such as on the former NSRR ROW, the guideway consists of a paved road designed for the loads associated with the buses that will use it. In high speed sections of the alignment, the two directions of travel will be separated by barriers, and paved shoulders will be provided. Barriers will also be located along the outside edge of the BRT guideway where drainage ditches are present. In areas where the BRT would operate at lower speeds, such as at stations or in the exclusive guideway in the median of Laskin Road (for the Hilltop Alternative), the barriers may be replaced with curbs or other traffic control devices. (**Figure 6-5**)

Figure 6-5| BRT Guideway (along NSRR ROW)



Source: HDR Engineering, 2014

BRT vehicles are capable of operating in mixed traffic, as standard transit buses do. The BRT NSRR Alternative and Hilltop Alternative extending to the Oceanfront Resort Area include segments where the vehicles would run on existing roads in mixed traffic. The BRT Alternatives would operate using high-capacity 60-foot articulated buses, transit signal priority at selected intersections, and passenger stations similar to those found on an LRT system. The BRT vehicle is larger than a standard city bus. Depending on the seating configuration of the bus, the vehicle can carry a maximum load of 100 seated and standing passengers. Unlike light rail trains, BRT vehicles cannot be joined to increase capacity;

instead, additional vehicles and/or higher service frequencies would be required. The vehicles used for the BRT alternatives would be similar to what is shown in **Figure 6-6**. The BRT vehicles are of low-floor design, and the station platforms would be coordinated with the vehicle design to allow for level boarding without the use of on-board ramps or bridge plates. It is assumed that vehicles selected for a BRT alternative would be powered by diesel fuel.

Figure 6-6| Bus Rapid Vehicle

Source: HDR Engineering, 2014

Where the BRT will cross public streets at-grade at high speeds, active warning devices such as railroad-type flashers and crossing gates may be used to supplement standard traffic signals at each location. In low-speed zones, standard traffic signals would be used to control traffic at grade crossings. When operating in mixed traffic, BRT vehicles would follow traffic signals and other devices as any other vehicle on the roadway. All warning devices, traffic signals, signs, and pavement markings will be in conformance with the current version of the Manual on Uniform Traffic Control Devices (MUTCD) and City of Virginia Beach standards.

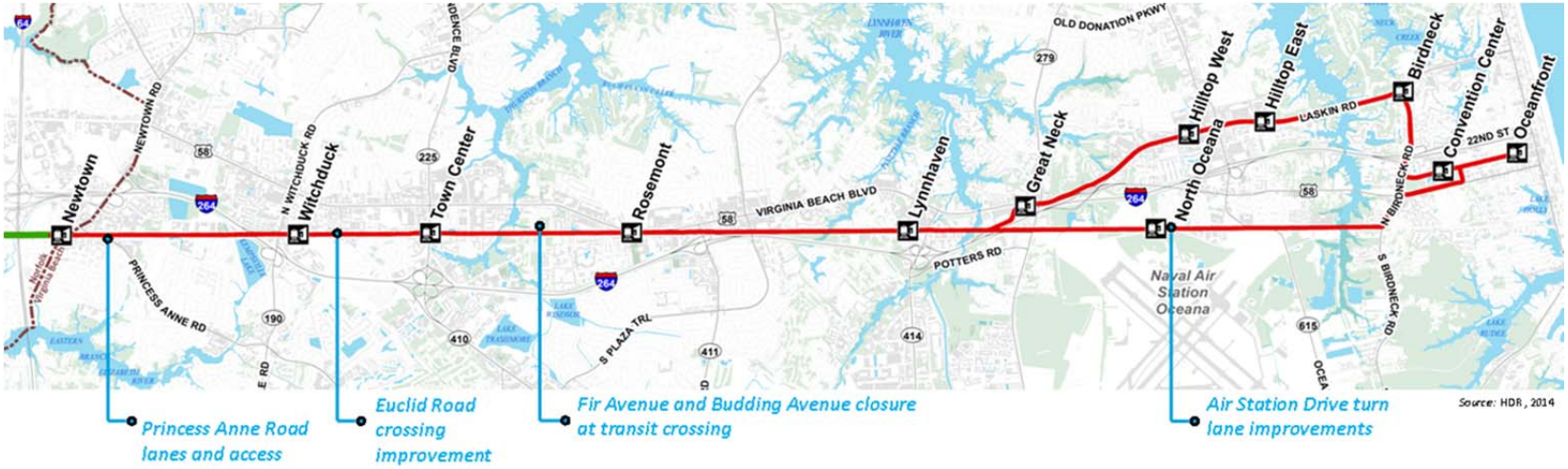
The construction, control devices, and operating plan for the BRT alternatives would be consistent with the LRT alternatives.

6.3 Physical Modifications

The Build Alternatives would require modifications to the future roadway network to construct and operate the transit service. The roadway improvements differ in the extent of modifications required in various segments (based on operations in the NSRR ROW or in dedicated lanes in the roadway), the provision of grade separation at key junctions, addition of new signals, and modifications required to existing traffic signals to accommodate the LRT or BRT movements.

Table 6-1 summarizes the physical modifications associated with each alternative required to improve pedestrian and vehicle safety, improve the speed and reliability of transit service, and/or minimize impacts to vehicular traffic. These improvements were included in the build conditions for the traffic analysis. See **Figure 6-7** for location of major roadway improvements.

Figure 6-7| Major Roadway Improvements associated with the Build Alternatives



Source: HDR Engineering, 2014

Table 6-1|Roadway Modifications for Build Alternatives

Location	ALTERNATIVES				Modification
	1A	1B	2	3	
Princess Anne Road crossing	●	●	●	●	Close southbound left turn lane on Princess Anne Road into driveway. Relocate driveway to west end of Southern Boulevard).
Princess Anne Road/Freight Lane intersection	●	●	●	●	Install new traffic signal. Add right turn lane on northbound Princess Anne Road.
S. Lowther Drive crossing	●	●	●	●	Crossing to be closed. Relocate access to Dominion Virginia Power substation via Southern Boulevard.
Witchduck Road crossing	●	●	●	●	Grade separated structure over Witchduck Road.
Euclid Road/Southern Boulevard/Opal Avenue intersection	●	●	●	●	Realign intersection to increase the distance between the crossing and the intersection.
Euclid Road/Holland Drive intersection	●	●	●	●	Realign intersection to increase the distance between the crossing and the intersection.
Independence Boulevard crossing	●	●	●	●	Grade separated structure over Independence Boulevard.
Market Street crossing	●	●	●	●	Grade separated structure over Market Street.
Fir Avenue crossing		●	●	●	Crossing to be closed. Fir Avenue south of tracks to become a dead end street. North of tracks, Fir Avenue to end at Southern Boulevard.
Budding Avenue crossing		●	●	●	Crossing to be closed. Budding Avenue south of tracks to become a dead end street. North of tracks, Budding Avenue to end at Southern Boulevard.
Lynn Shores Drive/Bonney Road intersection		●	●	●	Install new traffic signal.
Rosemont Road crossing			●	●	Grade separated structure over Rosemont Road.
North Plaza Trail, between former NSRR ROW and Virginia Beach Boulevard			●	●	Extend median to crossing. Reconfigure access to/from shopping centers north of former NSRR ROW.
Lynnhaven Parkway crossing			●	●	Grade separated structure over Lynnhaven Parkway
London Bridge Road crossing			●		Grade separated structure over London Bridge Road.
London Bridge Road crossing				LRT	Modify traffic signal for non-revenue light rail vehicle access to/from LRT VSMF.
Potters Road/Air Station Drive intersection			●		Add eastbound left turn lane and westbound right turn lane on Potters Road.
Birdneck Road, between Norfolk Avenue/Southern Boulevard and Virginia Beach Boulevard			LRT		Median breaks to be closed except at intersections with traffic signals.
Birdneck Road/Hope Avenue intersection			LRT		Install new traffic signal.
Washington Avenue, between Virginia Beach Boulevard (17th Street) and 19th Street			LRT		Street to be closed. 18th Street and Monroe Avenue to become dead end streets. Access to parking areas to be relocated.

Source: Fitzgerald & Halliday, Inc., 2014

Location (continued)	ALTERNATIVES				Modification
	1A	1B	2	3	
19th Street/Washington Avenue (LRT tracks) intersection			LRT		Install new traffic signal.
19th Street/Cypress Avenue intersection			LRT	LRT	Install new traffic signal.
19th Street/Mediterranean Avenue intersection			LRT	LRT	Install new traffic signal.
Virginia Beach Boulevard crossing (west of Great Neck Road)				LRT	Grade separated structure over Virginia Beach Boulevard.
Great Neck Road crossing				LRT	Grade separated structure over Great Neck Road.
Westbound Laskin Road crossing				LRT	Grade separated structure over westbound Laskin Road.
I-264 westbound on-ramp crossing (from Laskin Road)				LRT	Grade separated structure over on-ramp.
Laskin Road, from Phillip Avenue to Birdneck Road				●	Typical section changes to 3 lanes in each direction plus turn lanes, and eliminate service roads. Median breaks to be closed except at intersections with traffic signals.
Laskin Road/Phillip Avenue intersection				●	Install new traffic signal.
Laskin Road/First Colonial Road intersection				●	Grade separated structure for LRT or BRT over First Colonial Road. Roadway intersection to remain at grade.
Laskin Road/Winwood Drive intersection				●	Install new traffic signal.
Laskin Road/Linkhorn Bay Condominium entrance intersection				●	Install new traffic signal.
Birdneck Road, from Laskin Road to 19th Street				LRT	Median breaks to be closed except at intersections with traffic signals.
Birdneck Road/24th Street/Bluebird Drive intersection				LRT	Bluebird Drive to be realigned to 24th Street intersection. Existing Bluebird Drive to become dead end at Birdneck Road.
Birdneck Road/Maximus Square/Shopping center entrance intersection				LRT	Install new traffic signal.
Birdneck Road/Old Virginia Beach Road intersection				LRT	Install new traffic signal.
Birdneck Road under I-264				LRT	Relocate northbound lane to I-264 westbound on-ramp behind bridge piers.
19th Street, from Birdneck Road to Parks Avenue				LRT	Reduce number of lanes from 2 in each direction to 1 in each direction. LRT would be in exclusive lanes in the median of 19th Street.
19th Street/Convention Center parking lot entrance (west)				LRT	Install new traffic signal.
19thStreet/Jefferson Avenue (east Convention Center parking lot entrance)				LRT	Install new traffic signal.

Source: Fitzgerald & Halliday, Inc., 2014

6.4 Traffic Operations

6.4.1 Alternative 1A: Town Center Alternative

LRT Analysis

Results from the analysis, shown in **Table 6-2 and Figure 6-8,** indicate that three of the study area intersections will operate at LOS E or F during the morning or afternoon peak hours.

- Princess Anne Road and Newtown Road
- Independence and Columbus Street
- Independence Boulevard and Bonney Road/Euclid Road

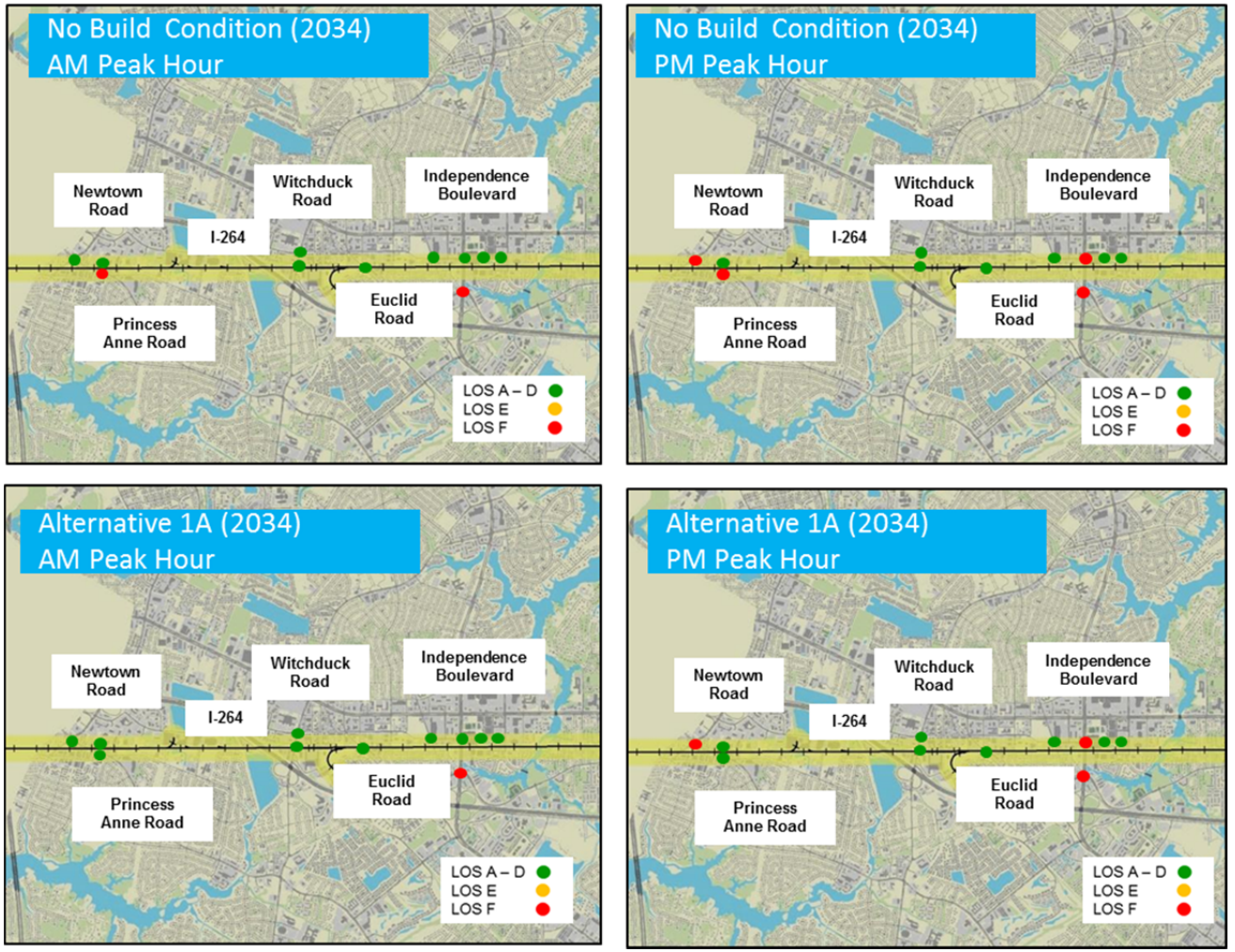
Traffic operations at the intersection of Princess Anne Road and Freight Lane would improve because of a new traffic signal proposed at this location. In general, the traffic operations under Alternative 1A would be similar to the No Build alternative. No intersections in the VBTES Corridor would have a lower LOS under Alternative 1A compared to the No Build alternative.

Table 6-2| Alternative 1A Intersection Level of Service Summary

Intersection	Control Type[1]	Build Condition (2034) AM Peak Hour LOS	Build Condition (2034) PM Peak Hour LOS
Princess Anne Road and Newtown Road	Signal	D	F
Princess Anne Road and Freight Lane	Signal[2]	A	B
Southern Boulevard and Freight Lane	SSSC	A	B
Witchduck Road and Cleveland Street	Signal	D	D
Witchduck Road and Southern Boulevard/I-264 WB On-Ramp	SSSC	B	B
Witchduck Road and Mac Street	N/A[3]	N/A[3]	N/A[3]
Southern Boulevard and Euclid Road/Opal Avenue	SSSC	D	D
Columbus Street and Kellam Road	Signal	B	C
Independence Boulevard and Columbus Street	Signal	C	F
Independence Boulevard and Bonney Road/Euclid Road	Signal	F	F
Market Street and Columbus Street	Signal	B	C
Columbus Street and Constitution Drive	Signal	C	C

[1] *SSSC: Side street stop controlled*
[2] *Proposed new signal*
[3] *Not applicable - Intersection of Witchduck Road and Mac Street to be closed as part of the Witchduck Road widening project.*
Source: Fitzgerald & Halliday, Inc., 2014

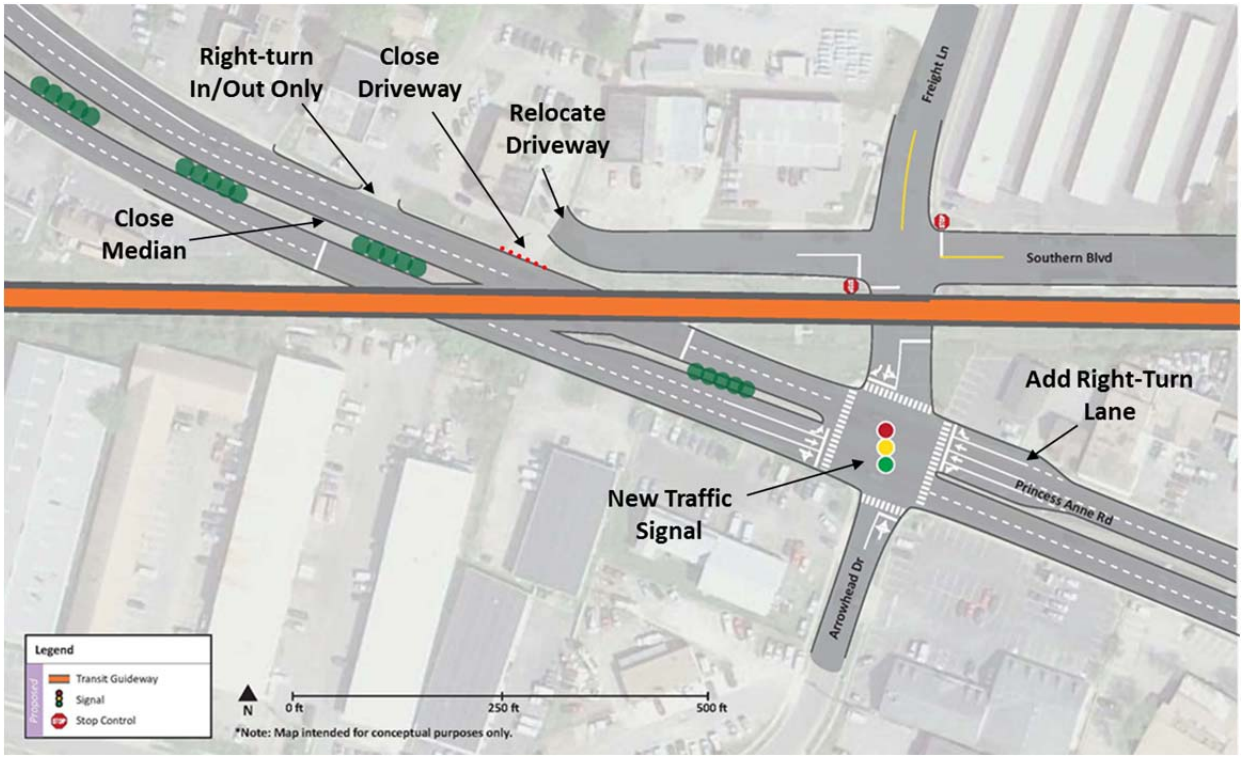
Figure 6-8| Alternative 1A Intersection Level of Service Summary



Source: Fitzgerald & Halliday, Inc., 2014

Modifications to the existing roadway network and traffic operations on Princess Anne Road and Euclid Road would benefit the transit operations and transitions. At the Princess Anne Road crossing, one driveway providing direct access to the property on the north side of Princess Anne Road would be closed to eliminate a conflict with the proposed guideway. Access to the property would be relocated by creating a driveway entrance at the west end of Southern Boulevard. A new traffic signal would be installed at the intersection of Princess Anne Road and Freight Lane to address safety concerns due to the short distance between the intersection and the track crossing. A new right turn lane would be installed for westbound Princess Anne Road at Freight Lane. (see **Figure 6-9**)

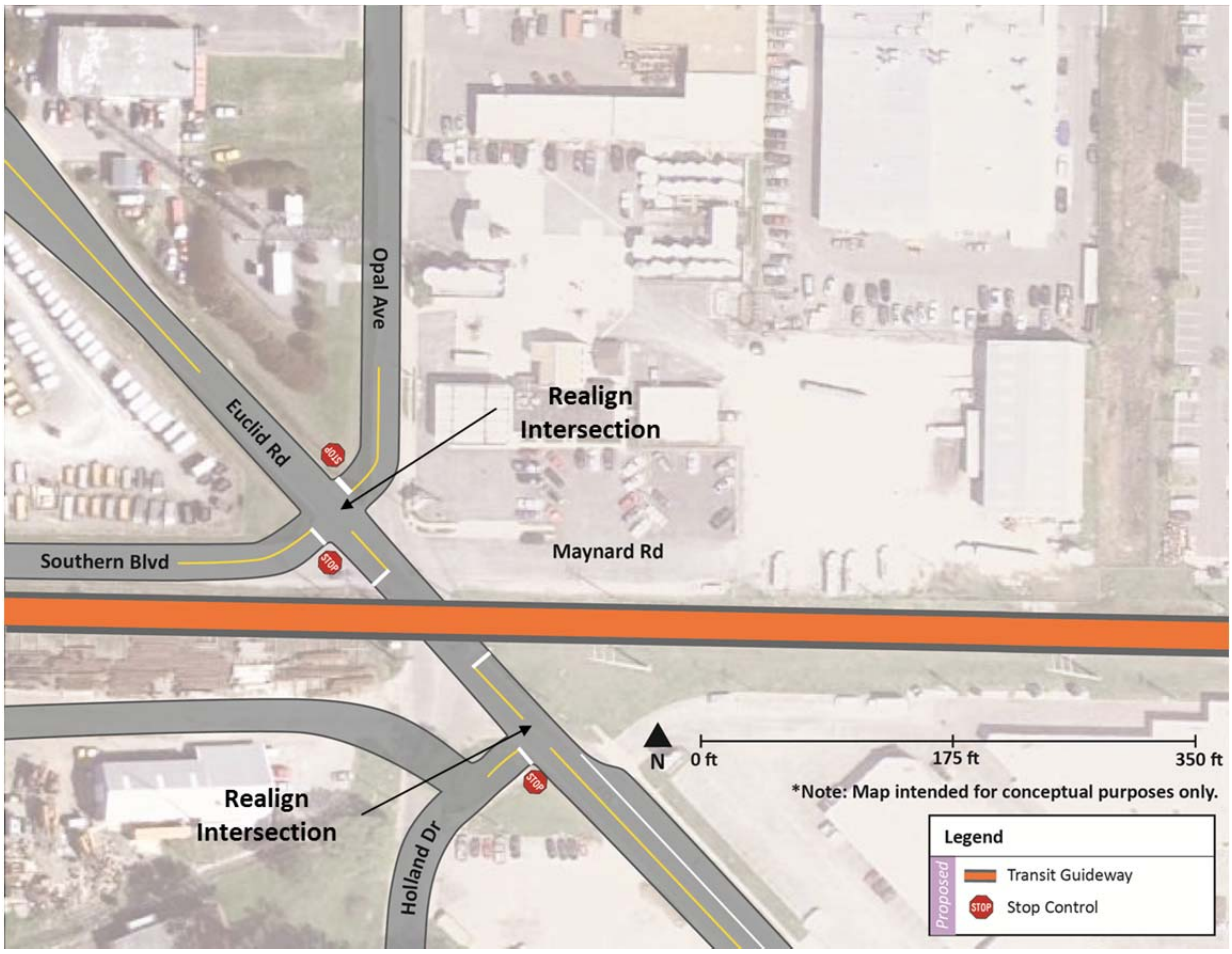
Figure 6-9| Roadway Improvements Near Princess Anne Road Crossing



Source: Fitzgerald & Halliday, Inc., 2014

Alternative 1A would cross at-grade with Euclid Road. The existing configuration of the intersection of Euclid Road with Southern Boulevard and Opal Avenue, and the intersection of Euclid Road with Holland Drive presents several line-of-sight challenges for motorists. Opal Avenue and Holland Drive alignments are skewed resulting in poor visibility of vehicles turning onto Euclid Road. The intersections of Euclid Road and Southern Boulevard/Opal Avenue and Euclid Road and Holland Drive are proposed to be realigned to increase the distance between the track crossing and the roadway intersections. Side street stop controls would remain, as traffic signals would not be warranted. (see **Figure 6-10**)

Figure 6-10| Roadway Improvements Near Euclid Road Crossing



Source: Fitzgerald & Halliday, Inc., 2014

BRT Analysis

The BRT Build Alternative 1A will operate in an exclusive guideway, and would require similar transportation improvements and have similar operational characteristics (frequency and speed) as the LRT Alternative 1A.

6.4.2 Alternative 1B: Rosemont Alternative

LRT Analysis

Results from the analysis, shown in **Table 6-3 and Figure 6-11,** indicate that five of the study area intersections will operate at LOS D, E, or F during the morning or afternoon peak hours.

- Princess Anne Road and Newtown Road
- Independence Boulevard and Columbus Street
- Independence Boulevard and Bonney Road/I-264 Westbound Off-Ramp
- Virginia Beach Boulevard and Rosemont Road

- Rosemont Road and Bonney Road/I-264 westbound Off-Ramp

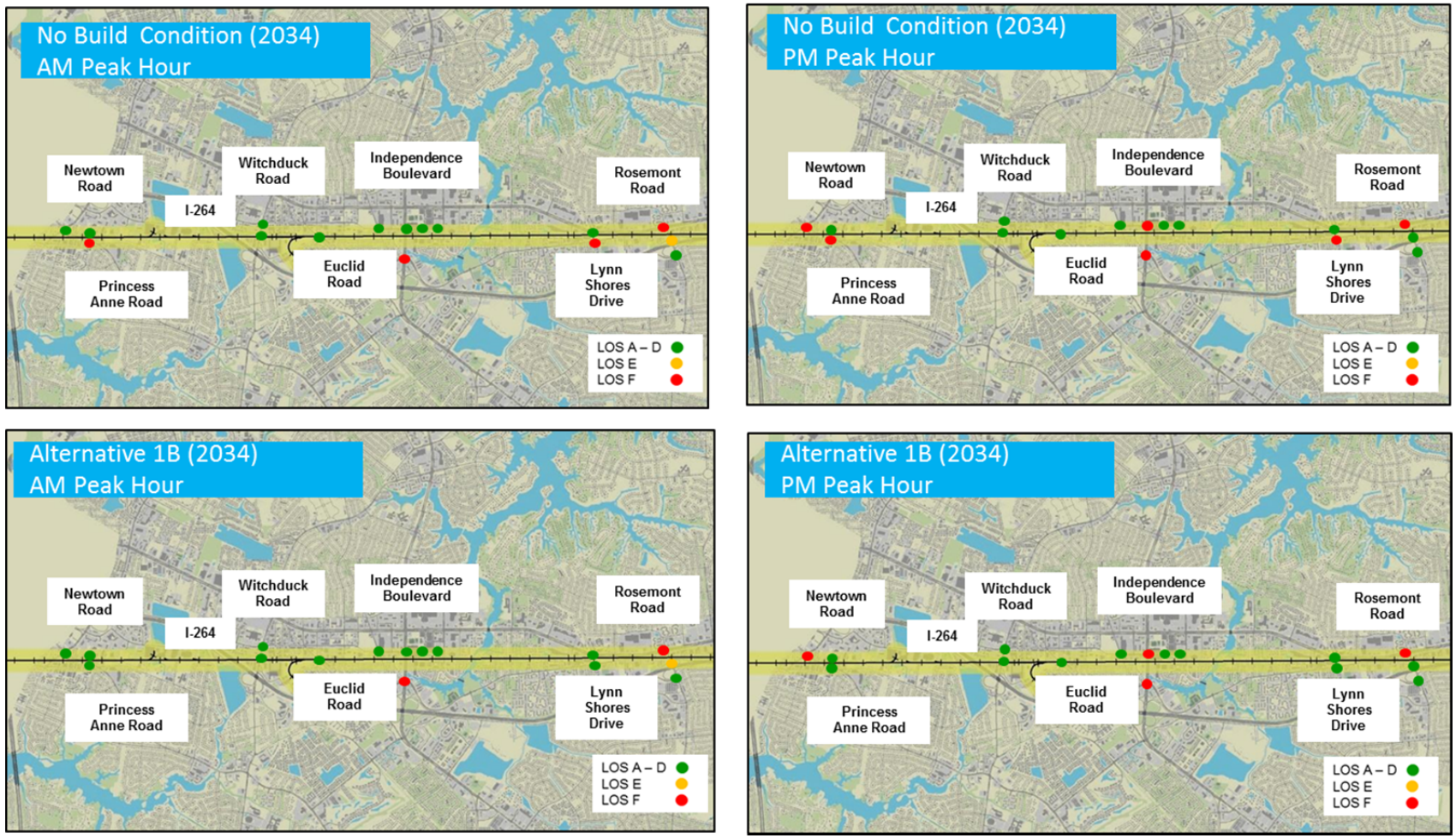
Two intersections (Princess Anne Road at Freight Lane and Lynn Shores Drive at Bonney Road) would have improved levels of service because of new traffic control devices required to safely operate Alternative 1B. In general, the traffic operations under Alternative 1B are similar to the No Build alternative. No intersections in the corridor would have a lower LOS under Alternative 1B compared to the No Build alternative.

Table 6-3| Alternative 1B Intersection Level of Service Summary

Intersection	Control Type[1]	Build Condition (2034) AM Peak Hour LOS	Build Condition (2034) PM Peak Hour LOS
Princess Anne Road and Newtown Road	Signal	D	F
Princess Anne Road and Freight Lane	Signal[2]	A	B
Southern Boulevard and Freight Lane	SSSC	A	B
Witchduck Road and Cleveland Street	Signal	D	D
Witchduck Road and Southern Boulevard/I-264 WB On-Ramp	SSSC	B	B
Witchduck Road and Mac Street	N/A[3]	N/A[3]	N/A[3]
Southern Boulevard and Euclid Road/Opal Avenue	SSSC	D	D
Columbus Street and Kellam Road	Signal	B	C
Independence Boulevard and Columbus Street	Signal	C	F
Independence Boulevard and Bonney Road/Euclid Road	Signal	F	F
Market Street and Columbus Street	Signal	B	C
Columbus Street and Constitution Drive	Signal	C	C
Lynn Shores Drive and Virginia Beach Boulevard	Signal	A	B
Lynn Shores Drive and Bonney Road	Signal[2]	B	C
Virginia Beach Boulevard and Rosemont Road	Signal	F	F
Rosemont Road and Bonney Road/I-264 WB Off-Ramp	Signal	E	D
Rosemont Road and I-264 EB Ramps	Signal	C	C

[1] *SSSC: Side street stop controlled*
[2] *Proposed new signal*
[3] *Not applicable - Intersection of Witchduck Road and Mac Street to be closed as part of the Witchduck Road widening project.*
Source: Fitzgerald & Halliday, Inc., 2014

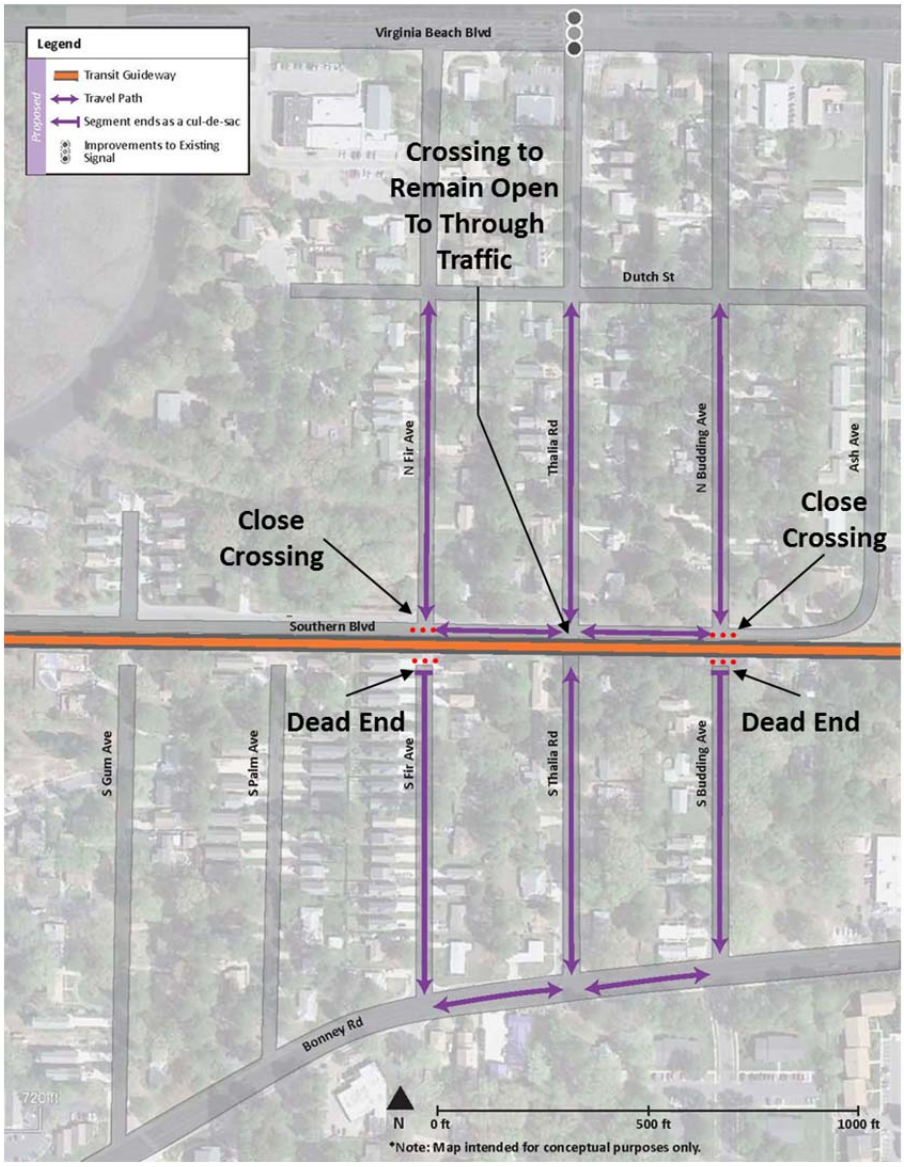
Figure 6-11| Alternative 1B Intersection Level of Service Summary



Source: Fitzgerald & Halliday, Inc., 2014

Modifications to the existing roadway network and traffic operations under Alternative 1A would be identical to Alternative 1B. Additionally, Alternative 1B would extend along the exclusive guideway through the neighborhood east of Thalia Creek. Currently, there are three at-grade street crossings in this neighborhood: North Fir Avenue, Thalia Road, and North Budding Avenue. Thalia Road serves significantly more traffic than North Budding and Fir Avenues and is signalized at Virginia Beach Boulevard. To avoid having multiple at-grade crossings in a short distance, existing crossings at Fir Avenue and Budding Avenue would be closed and an at-grade crossing of Thalia Road would remain. South Fir Avenue and South Budding Avenue would become dead end streets south of the tracks (north of the tracks, those streets would end at Southern Boulevard, which runs parallel to the former NSRR ROW). Drivers would be able to access Thalia Road via Bonney Road. Southern Boulevard would remain open with full access between the three roadways north of the exclusive guideway. (see **Figure 6-12**)

Figure 6-12| Changes to Fir Road, Thalia Road, and Budding Avenue Crossings



Source: Fitzgerald & Halliday, Inc., 2014

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Alternative 1B would cross at-grade with Kentucky Avenue and Lynn Shores Drive. The intersection of Lynn Shores Drive with Bonney Road is currently unsignalized and provides direct access to Virginia Beach Boulevard. Heavy peak hour traffic volume along Bonney Road leads to long delays for southbound traffic on Lynn Shores Drive attempting to make a left-turn, resulting in queuing. To ensure safe operations, the northbound stop bar on Lynn Shores Drive approaching Virginia Beach Boulevard would be moved back approximately 75 feet equivalent to three queued vehicles. This would result in a reduction in the storage space between Bonney Road and Virginia Beach Boulevard to approximately 200 feet, or eight queued vehicles. Right turn on red would be restricted; therefore, northbound queues are expected to extend back to the intersection of Lynn Shores Drive with Bonney Road. The intersection of Lynn Shores Drive with Bonney Road would be signalized to control potential southbound queuing over the fixed guideway and northbound queuing which may extend through the intersection of Lynn Shores Drive with Bonney Road. Alternative 1B terminates at the Rosemont Station, which is proposed immediately east of Lynn Shores Drive.

In general, the traffic operations under Alternative 1B are similar to the No Build Alternative. While the addition of new traffic signals and modifications to existing signals, roadway, and access will increase delay in the corridor, traffic congestion and long delays at these intersections are primarily attributed to traffic demand and growth that naturally occurs over time.

BRT Analysis

The BRT Build Alternative 1B will operate in an exclusive guideway, and would require similar transportation improvements and have similar operational characteristics (frequency and speed) as the LRT Alternative 1B.

6.4.3 Alternative 2: NSRR Alternative

LRT Analysis

Under Alternative 2, results from the analysis shown in **Table 6-4** and **Figures 6-13 and 6-14** indicate that a total of seven intersections will operate at LOS E or F during the morning or afternoon peak hours.

- Princess Anne Road and Newtown Road
- Independence Boulevard and Columbus Street
- Independence Boulevard and Bonney Road/I-264 Westbound Off-Ramp
- Virginia Beach Boulevard and Rosemont Road
- Rosemont Road and Bonney Road/I-264 Westbound off-ramp
- North Plaza Trail and Virginia Beach Boulevard
- Lynnhaven Parkway and Southern Boulevard

In general, the traffic operations under Alternative 2 would be similar to the No Build alternative. Six intersections, as listed below, would have improved level of service during AM or PM peak conditions because of new traffic control devices, modifications to the roadway, or changes to signal operations required to safely operate the build alternative.

- Princess Anne Road and Freight Lane
- Lynn Shores Drive and Bonney Road
- Birdneck Road and Norfolk Avenue/Southern Boulevard
- Birdneck Road and Burford Avenue
- Birdneck Road and Hope Avenue
- Virginia Beach Boulevard and Jefferson Avenue

The intersections at Birdneck Road and Norfolk Avenue/Southern Boulevard and Birdneck Road and Virginia Beach Boulevard would experience an increase in delay due to the changes in signal phasing required to accommodate transit operations and the transitions to and from the median of Birdneck Road. Both of these intersections would be expected to operate at LOS D or better during the AM or PM peak hours.

Table 6-4| Alternative 2 Intersection Level of Service Summary

Intersection	Control Type[1]	Build Condition (2034) AM Peak Hour LOS	Build Condition (2034) PM Peak Hour LOS
Princess Anne Road and Newtown Road	Signal	D	F
Princess Anne Road and Freight Lane	Signal[2]	A	B
Southern Boulevard and Freight Lane	SSSC	A	B
Witchduck Road and Cleveland Street	Signal	D	D
Witchduck Road and Southern Boulevard/I-264 WB On-Ramp	SSSC	B	B
Witchduck Road and Mac Street	N/A[3]	N/A[3]	N/A[3]
Southern Boulevard and Euclid Road/Opal Avenue	SSSC	D	D
Columbus Street and Kellam Road	Signal	B	C
Independence Boulevard and Columbus Street	Signal	C	F
Independence Boulevard and Bonney Road/Euclid Road	Signal	F	F
Market Street and Columbus Street	Signal	B	C
Columbus Street and Constitution Drive	Signal	C	C
Lynn Shores Drive and Virginia Beach Boulevard	Signal	A	B
Lynn Shores Drive and Bonney Road	Signal[2]	B	C
Virginia Beach Boulevard and Rosemont Road	Signal	F	F
Rosemont Road and Bonney Road/I-264 WB Off-Ramp	Signal	E	D
Rosemont Road and I-264 EB Ramps	Signal	C	C
North Plaza Trail and Virginia Beach Boulevard	Signal	D	E
N. Lynnhaven Road and Southern Boulevard	SSSC	C	D
Lynnhaven Parkway and Southern Boulevard	SSSC	F	F
Lynnhaven Parkway and Lynnhaven Road/I-264 WB Off-Ramp	Signal	C	D
Potters Road and Air Station Drive	SSSC	A	B
First Colonial Road and Oceana Boulevard	Signal	C	C

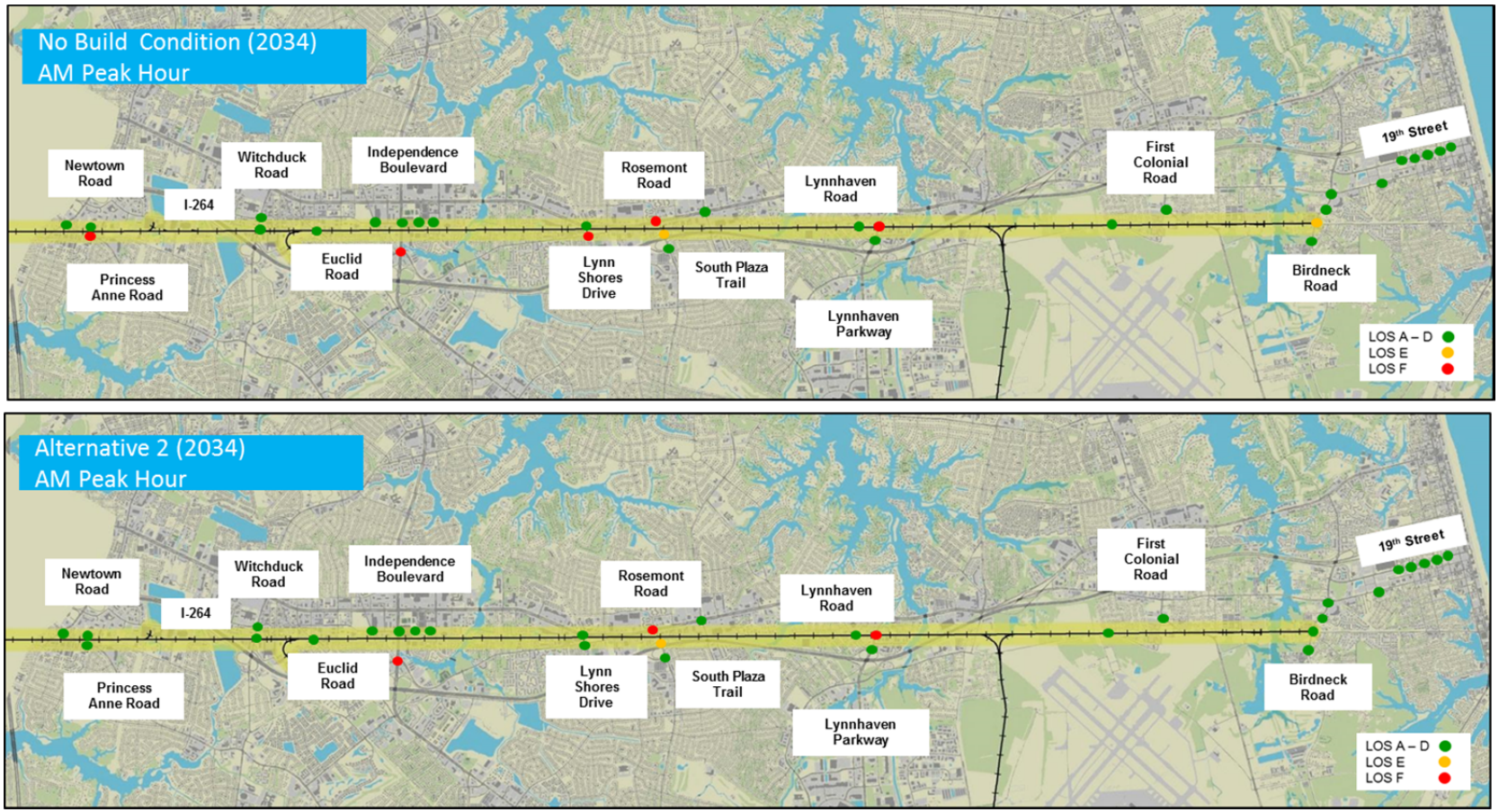
[1] *SSSC: Side street stop controlled*
[2] *Proposed new signal*
[3] *Not applicable - Intersection of Witchduck Road and Mac Street to be closed as part of the Witchduck Road widening project.*
Source: Fitzgerald & Halliday, Inc., 2014

Table 6-4| Alternative 2 Intersection Level of Service Summary (continued)

Intersection	Control Type[1]	Build Condition (2034) AM Peak Hour LOS	Build Condition (2034) PM Peak Hour LOS
Birdneck Road and Norfolk Avenue/Southern Boulevard	Signal	D	D
Birdneck Road and Burford Avenue	Signal	B	A
Birdneck Road and Hope Avenue	Signal[2]	A	A
Birdneck Road and Virginia Beach Boulevard/17th Street	Signal	D	D
Virginia Beach Boulevard and Jefferson Avenue	Signal[2]	B	B

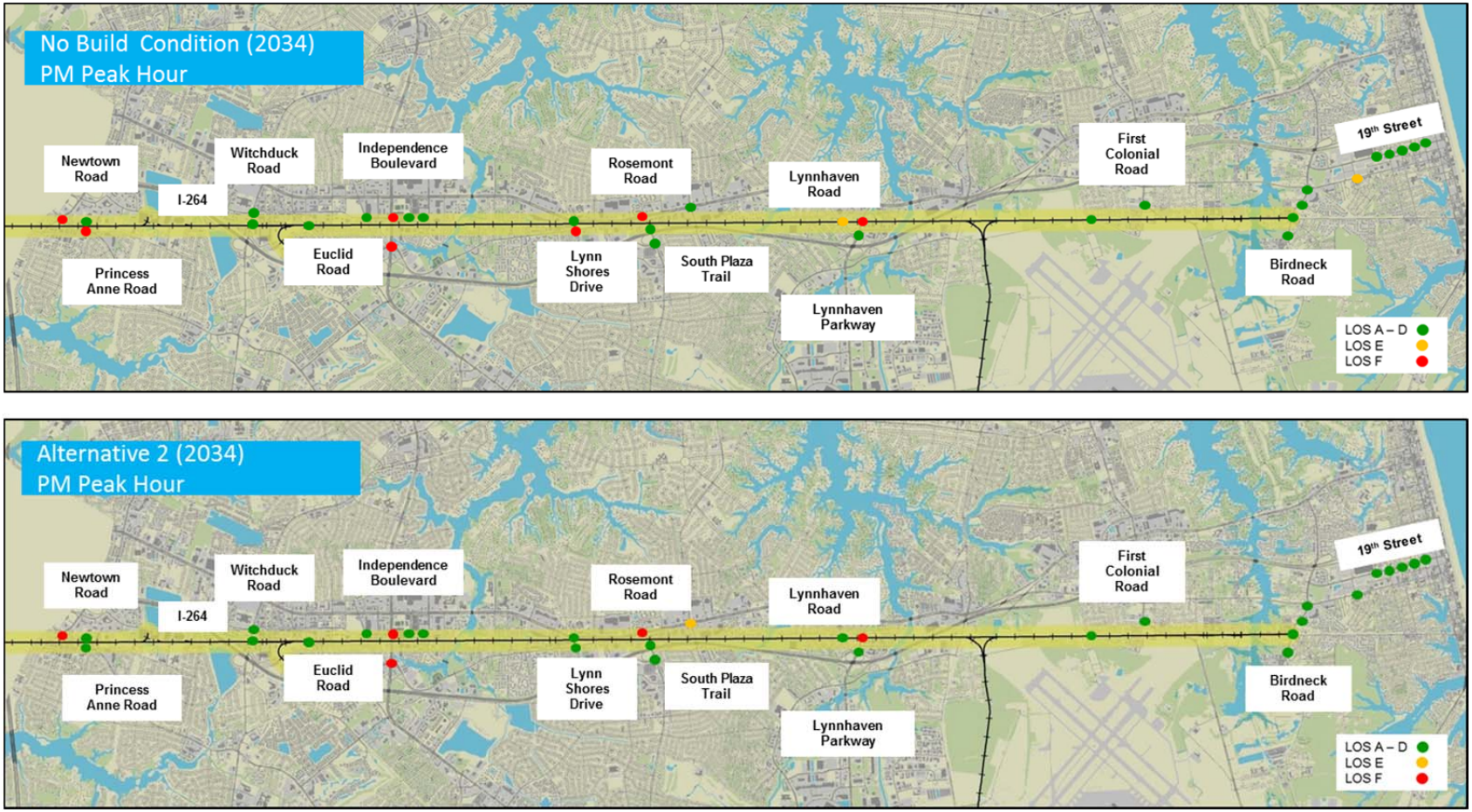
Proposed new signal
[3]Not applicable - Intersection of Witchduck Road and Mac Street to be closed as part of the Witchduck Road widening project.
Source: Fitzgerald & Halliday, Inc., 2014

Figure 6-13| Alternative 2 Intersection Level of Service Summary – AM Peak Hour



Source: Fitzgerald & Halliday, Inc., 2014

Figure 6-14| Alternative 2 Intersection Level of Service Summary – PM Peak Hour



Source: Fitzgerald & Halliday, Inc., 2014

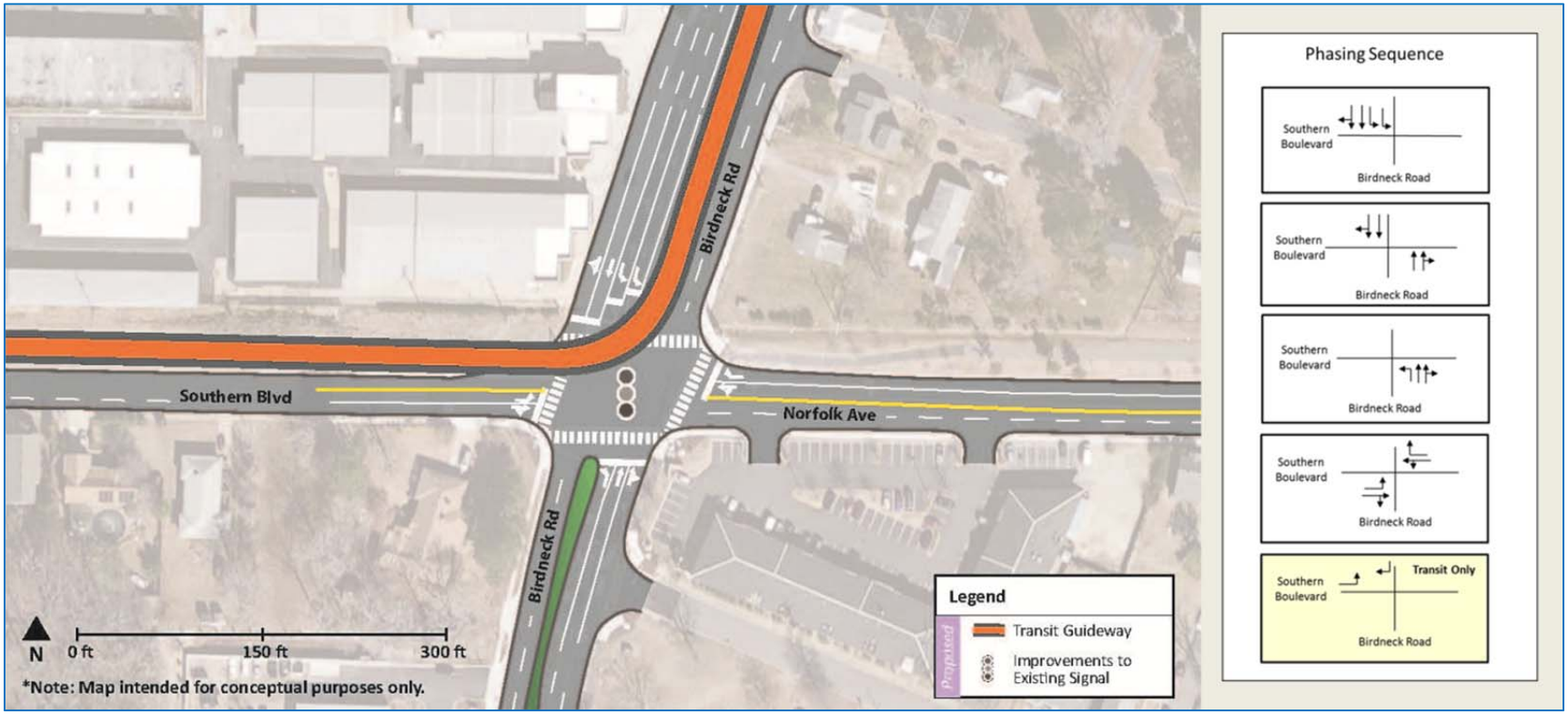
Modifications to the existing roadway network and traffic operations under Alternative 1B would be identical to Alternative 2. Additionally, modifications on Potters Road, Birdneck Road, and 17th Street would benefit the transit operations and transitions. Potters Road is a two-lane roadway (one lane in each direction) that provides access to the neighborhood just north of the Navy base. To provide additional space for vehicles due to the short distance between the crossing and Potters Road, an eastbound left-turn lane and a westbound right-turn lane would be provided on Potters Road. (see **Figure 6-16**)

Figure 6-15| Roadway Improvements Near Air Station Drive Crossing

Source: Fitzgerald & Halliday, Inc., 2014

Alternative 2 would extend from the exclusive guideway on the NSRR ROW to its intersection with Birdneck Road and would have embedded tracks on Birdneck Road, 17th Street, Washington Avenue, and 19th Street. An additional phase to accommodate the transit vehicles turning from the guideway onto Birdneck Road would be added to the signal system at the intersection of Birdneck Road with Norfolk Avenue/Southern Boulevard. Birdneck Road would be realigned to maintain the existing capacity and include the exclusive guideway for the LRT. The intersection of Birdneck Road with Norfolk Avenue/Southern Boulevard would maintain its current lane capacity, including two through travel lanes in each direction on Birdneck and dual southbound left turn lanes from Birdneck Road onto Norfolk Avenue. (see **Figure 6-17**)

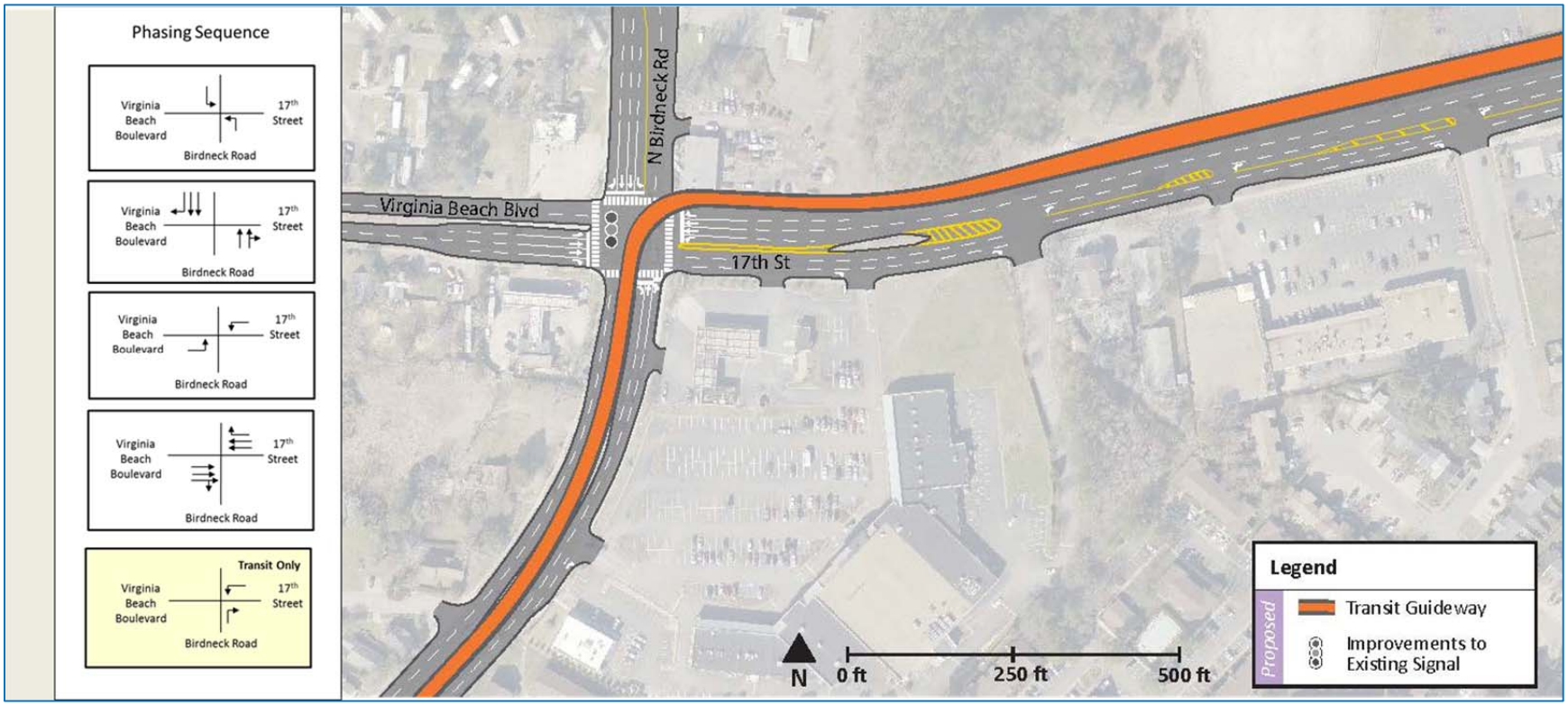
Figure 6-16| Birdneck Road/Southern Boulevard Improvements



Source: Fitzgerald & Halliday, Inc., 2014

At the intersection of Birdneck Road with Virginia Beach Boulevard, an additional phase to accommodate the LRT vehicles turning from Birdneck Road onto the guideway on the north side of Virginia Beach Boulevard would be added to the signal system. (see **Figure 6-18**)

Figure 6-17| Birdneck Road/Virginia Beach Boulevard Improvements

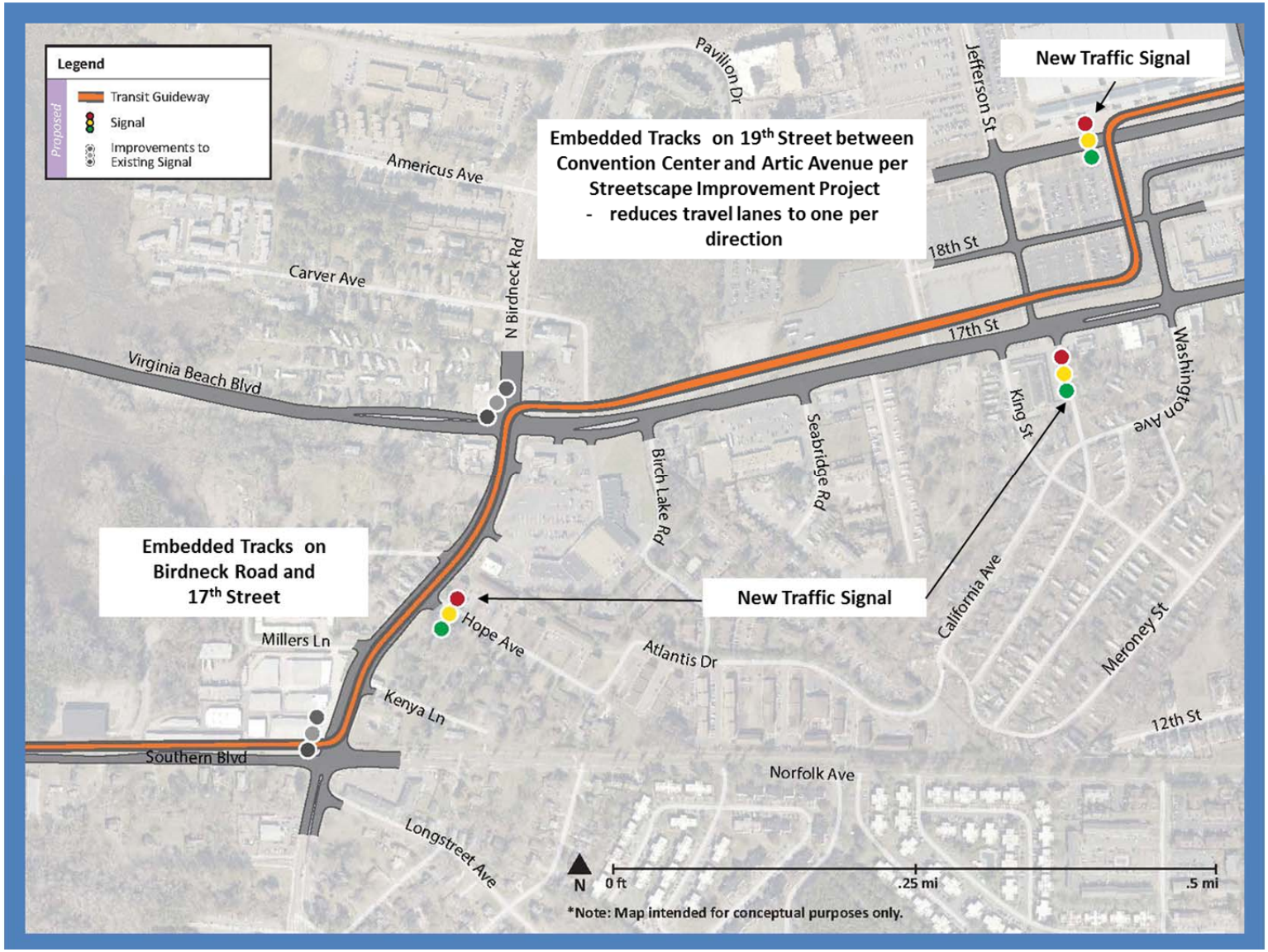


Source: Fitzgerald & Halliday, Inc., 2014

In the oceanfront area, the western entrance to the Convention Center parking lots would be closed. The eastern entrance, also known as Jefferson Avenue, would remain open with a new signal at its intersection with Virginia Beach Boulevard. The LRT would traverse north on Washington Avenue to the Convention Center station and then to 19th Street. A new signal would be installed at the location where the transit guideway intersects with 19th Street at the Convention Center. Cul-de-sacs on 18th Street and Monroe Avenue just east of the Virginia Beach Convention Center parking lot would be constructed to eliminate crossings of the guideway.

On 19th Street, Alternative 2 would reduce one vehicular travel lane in each direction between the new signal on 19th Street at the Convention Center and Arctic Avenue. The LRT build alternative would operate in the exclusive guideway in the center of the roadway. New signals at the intersections of 19th Street and Cypress Avenue, and 19th Street and Mediterranean Avenue would be installed. (see **Figure 6-19**)

Figure 6-18| Birdneck Road to 17th Street Corridor Recommendations



Source: Fitzgerald & Halliday, Inc., 2014

In general, the traffic operations under Alternative 2 are similar to the No Build Alternative. The intersections of Birdneck Road and Southern Boulevard/Norfolk Avenue, Birdneck Road and Burford Avenue, and Birdneck Road and Virginia Beach Boulevard/17th Street will experience an increase in delay to accommodate safe and efficient transit operations and transitions but will operate at LOS D or better (compared to the No Build Alternative). While the addition of new traffic signals and modifications to existing signals, roadway, and access will increase delay in the corridor, traffic congestion and long delays at these intersections are primarily attributed to traffic demand and growth that naturally occurs over time.

BRT Analysis

Where the BRT build alternative operates in exclusive guideway, the transit system would require similar transportation improvements and have similar operational characteristics (frequency and speed) as the LRT build alternative. As such, the impacts of the BRT Alternative 2 would be the same as the LRT Alternative 2, west of Birdneck Road.

At Birdneck Road, the BRT vehicles would exit the exclusive guideway and turn north on Birdneck Road. The BRT would operate in mixed traffic on Birdneck Road, Virginia Beach Boulevard, and 19th Street until it reaches the terminal station at the Oceanfront Resort Area and would not receive any traffic signal priority or other preferential treatment. The BRT vehicles would be expected to adhere to traffic regulations, existing traffic signals and other control devices.

6.4.4 Alternative 3: Hilltop Alternative

LRT Analysis

Under Alternative 3, the results from the analysis shown in **Table 6-5** and in **Figures 6-20 and 6-21** indicate that a total of eight intersections will operate at LOS E or F during the morning or afternoon peak hours**:**

- Princess Anne Road and Newtown Road
- Independence and Columbus Street
- Independence Boulevard and Bonney Road/I-264 Westbound Off-Ramp
- Virginia Beach Boulevard and Rosemont Road
- Rosemont Road and Bonney Road/I-264 westbound off-ramp
- North Plaza Trail and Virginia Beach Boulevard
- Lynnhaven Parkway and Southern Boulevard
- Virginia Beach Boulevard and Great Neck Road/London Bridge Road

In general, the traffic operations under Alternative 3 would be similar to the No Build alternative. Ten intersections, as listed below, would have improved level of service during AM or PM peak conditions

because of new traffic control devices, modifications to the roadway, or changes to signal operations required to safely operate the build alternative. These intersections are expected to operate at LOS D or better during AM and PM peak hour conditions.

- Princess Anne Road and Freight Lane
- Lynn Shores Drive and Bonney Road
- Laskin Road and Phillip Avenue
- Laskin Road and Winwood Drive
- Laskin Road and Linkhorn Bay Condominium Entrance
- Laskin Road and Oriole Drive
- Birdneck Road and Maximus Square
- Birdneck Road and Old Virginia Beach Boulevard
- 19th Street and West Convention Center Parking Lot Entrance
- 19th Street and Mediterranean Avenue

Table 6-5| Alternative 3 Intersection Level of Service Summary

Intersection	Control Type[1]	Build Condition (2034) AM Peak Hour LOS	Build Condition (2034) PM Peak Hour LOS
Princess Anne Road and Newtown Road	Signal	D	F
Princess Anne Road and Freight Lane	Signal[2]	A	B
Southern Boulevard and Freight Lane	SSSC	A	B
Witchduck Road and Cleveland Street	Signal	D	D
Witchduck Road and Southern Boulevard/I-264 WB On-Ramp	SSSC	B	B
Witchduck Road and Mac Street	N/A[3]	N/A[3]	N/A[3]
Southern Boulevard and Euclid Road/Opal Avenue	SSSC	D	D
Columbus Street and Kellam Road	Signal	B	C
Independence Boulevard and Columbus Street	Signal	C	F
Independence Boulevard and Bonney Road/Euclid Road	Signal	F	F
Market Street and Columbus Street	Signal	B	C
Columbus Street and Constitution Drive	Signal	C	C

[1] *SSSC: Side street stop controlled*
[2] *Proposed new signal*
[3] *Not applicable - Intersection of Witchduck Road and Mac Street to be closed as part of the Witchduck Road widening project.*
Source: Fitzgerald & Halliday, Inc., 2014

Table 6-5| Alternative 3 Intersection Level of Service Summary (continued)

Intersection	Control Type[1]	Build Condition (2034) AM Peak Hour LOS	Build Condition (2034) PM Peak Hour LOS
Lynn Shores Drive and Virginia Beach Boulevard	Signal	A	B
Lynn Shores Drive and Bonney Road	Signal[2]	B	C
Virginia Beach Boulevard and Rosemont Road	Signal	F	F
Rosemont Road and Bonney Road/I-264 WB Off-Ramp	Signal	E	D
Rosemont Road and I-264 EB Ramps	Signal	C	C
North Plaza Trail and Virginia Beach Boulevard	Signal	D	E
N. Lynnhaven Road and Southern Boulevard	SSSC	C	D
Lynnhaven Parkway and Southern Boulevard	SSSC	F	F
Lynnhaven Parkway and Lynnhaven Road/I-264 WB Off-Ramp	Signal	C	D
Virginia Beach Boulevard and Hutton Lane/Parker Lane	Signal	C	C
Virginia Beach Boulevard and Byrd Lane	Signal	B	C
Virginia Beach Boulevard and Great Neck Road/London Bridge Road	Signal	F	F
Laskin Road and Phillip Avenue	Signal[2]	B	B
Laskin Road and Regency Hilltop Shopping Center	Signal	A	B
Laskin Road and Regency Drive	Signal	C	D
Laskin Road and Republic Road	Signal	B	C
Laskin Road and Hilltop Plaza Shopping Center	Signal	A	B
Laskin Road and First Colonial Road	Signal	D	D
First Colonial Road and Donna Boulevard	Signal	C	D
Laskin Road and Hilltop North Shopping Center	Signal	B	C
Laskin Road and Hilltop East Shopping Center	Signal	A	B
Laskin Road and Winwood Drive	Signal[2]	B	B
Laskin Road and Linkhorn Bay Condominium Entrance	Signal[2]	C	B
Laskin Road and Cardinal Road	Signal	B	B
Laskin Road and Birdneck Road	Signal	D	D
Laskin Road and Oriole Drive	Signal	B	A

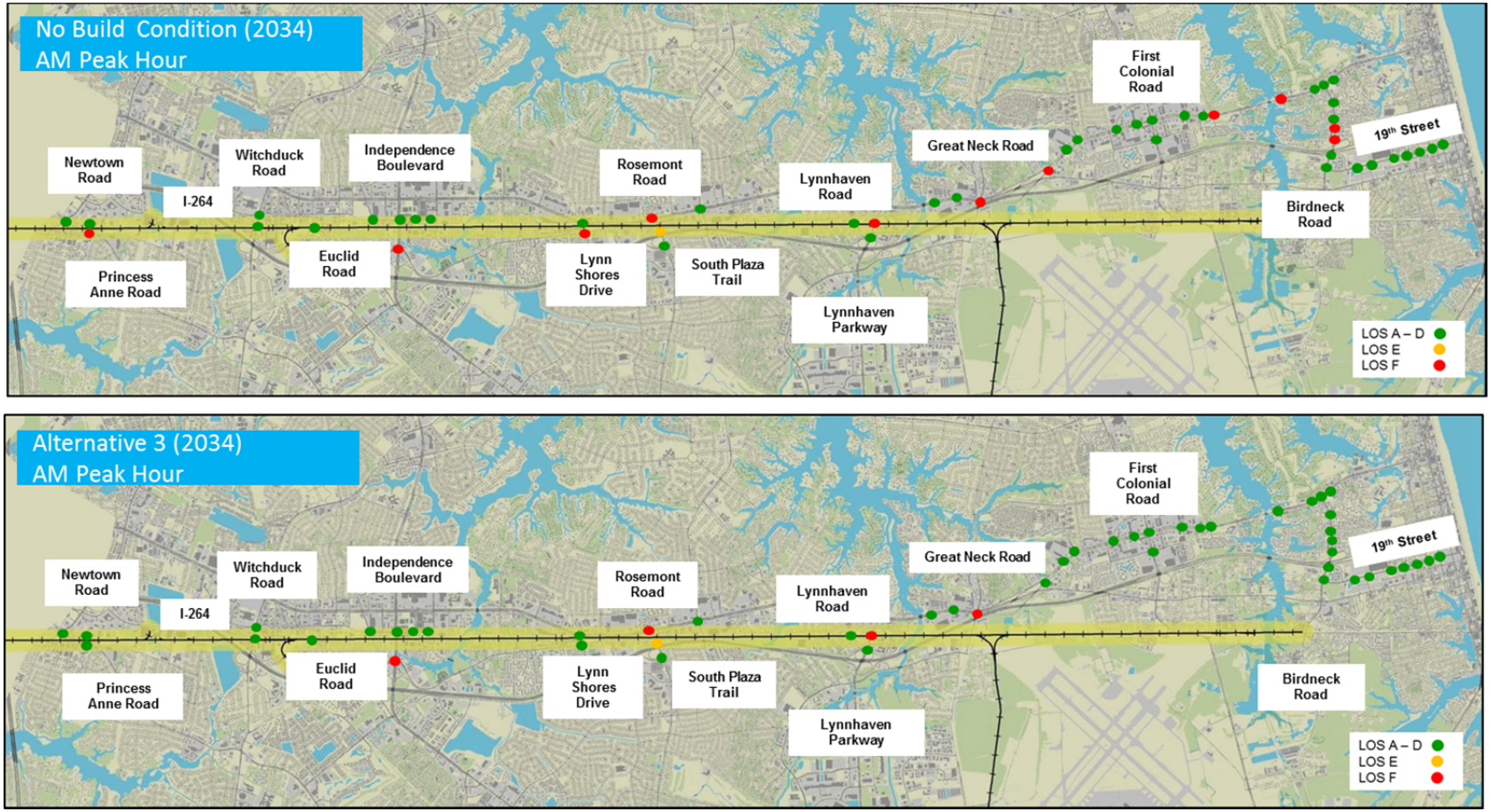
[1]*SSSC: Side street stop controlled*
[2]*Proposed new signal*
Source: Fitzgerald & Halliday, Inc., 2014

Table 6-5| Alternative 3 Intersection Level of Service Summary (continued)

Intersection	Control Type[1]	Build Condition (2034) AM Peak Hour LOS	Build Condition (2034) PM Peak Hour LOS
Birdneck Road and 24th Street	Signal	B	B
Birdneck Road and Waterfront Drive	Signal	B	B
Birdneck Road and Maximus Square	Signal[2]	A	A
Birdneck Road and Old Virginia Beach Boulevard	Signal[2]	A	B
Birdneck Road and I-264 EB Off-Ramp	Signal	B	B
Birdneck Road and 19th Street/Americus Avenue	Signal	C	C
19th Street and West Convention Center Parking Lot Entrance	Signal[2]	B	A
19th Street and East Convention Center Parking Lot Entrance	Signal	B	B
19th Street and Parks Avenue	Signal	B	B
19th Street and Cypress Avenue	Signal[2]	B	B
19th Street and Mediterranean Avenue	Signal[2]	B	B
19th Street and Baltic Avenue	Signal	B	C
19th Street and Artic Avenue	Signal	C	C

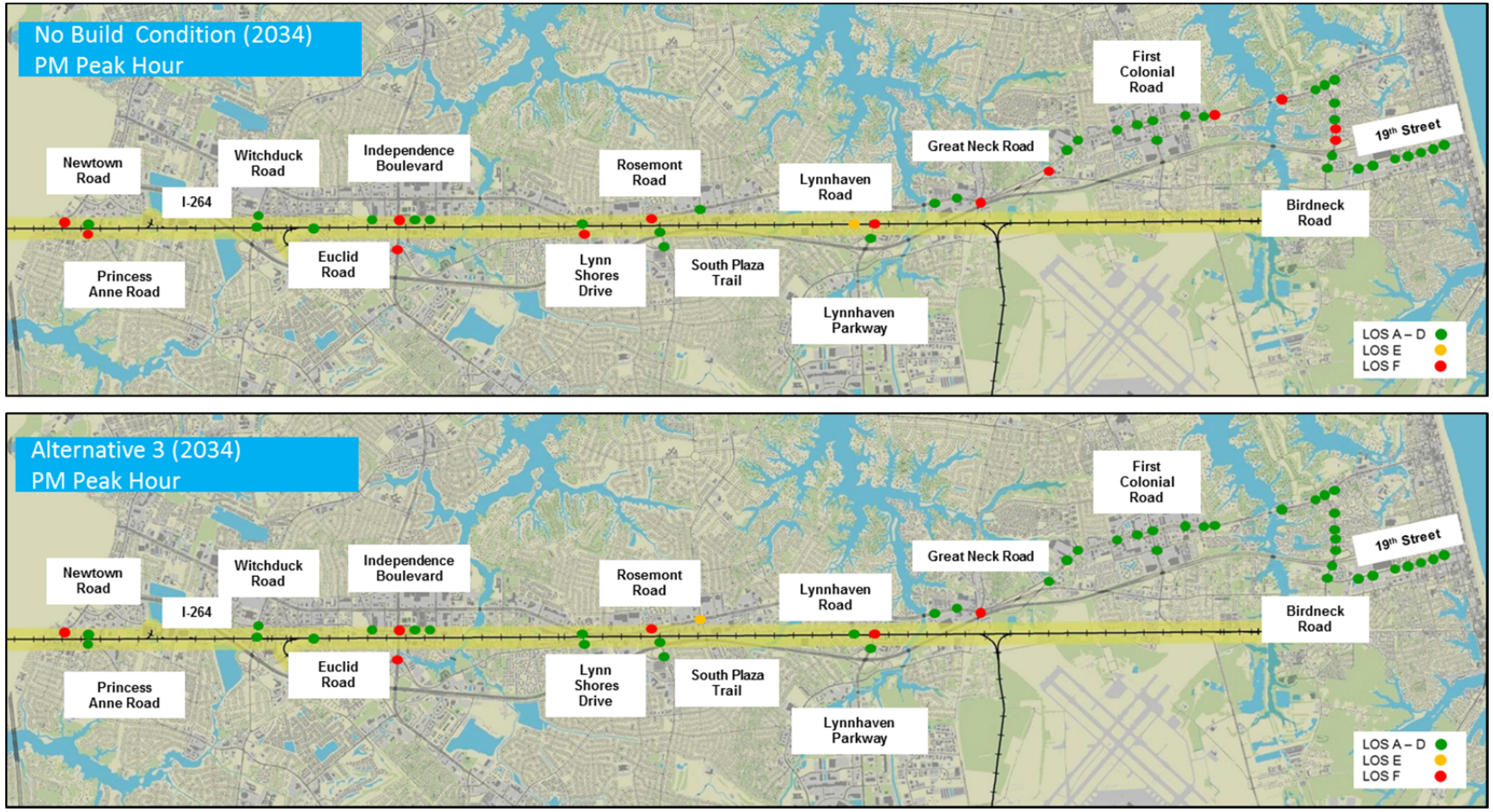
[1]*SSSC: Side street stop controlled*
[2]*Proposed new signal*
Source: Fitzgerald & Halliday, Inc., 2014

Figure 6-19|Alternative 3 Intersection Level of Service Summary – AM Peak Hour



Source: Fitzgerald & Halliday, Inc., 2014

Figure 6-20| Alternative 3 Intersection Level of Service Summary – PM Peak Hour

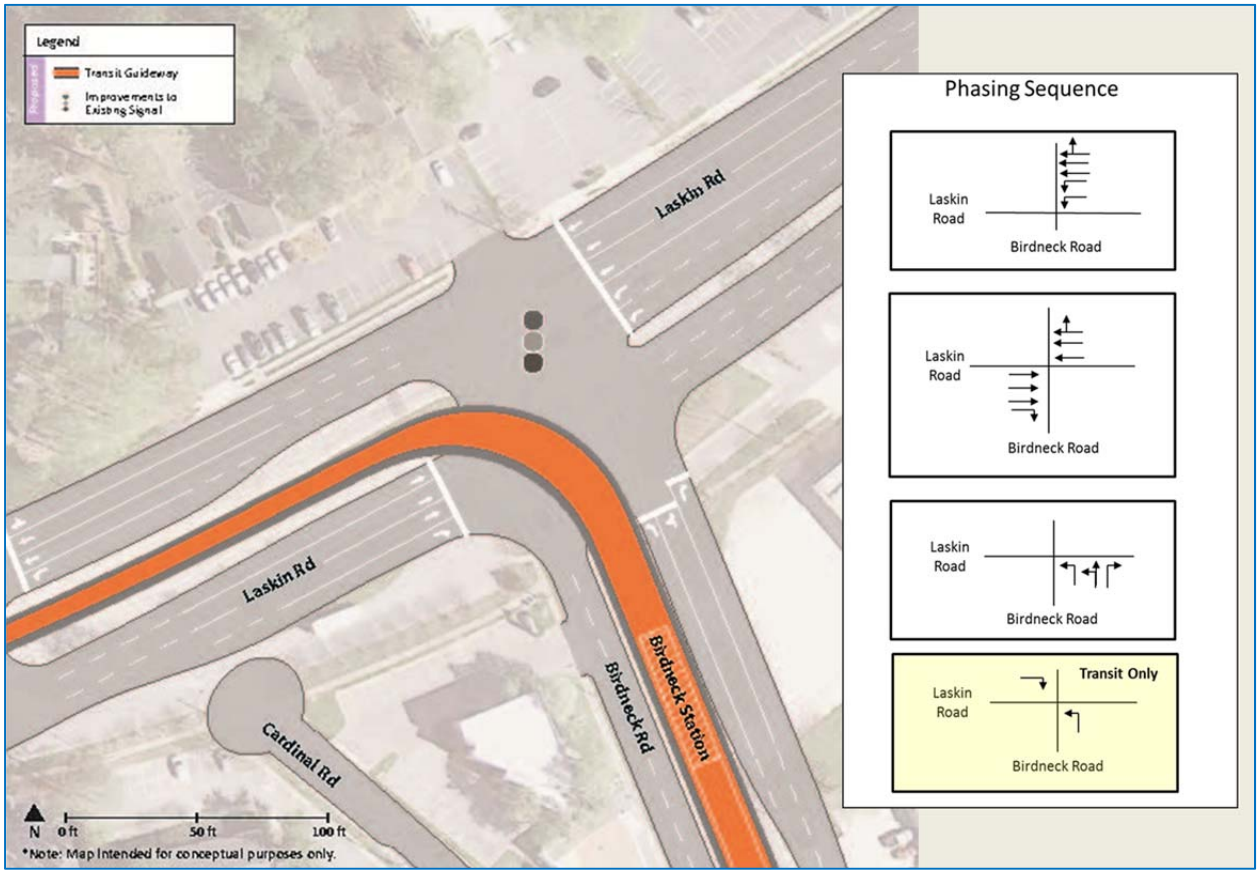


Source: Fitzgerald & Halliday, Inc., 2014

Where the LRT Build Alternative operates in the exclusive guideway on the NSRR ROW west of Great Neck Road, the transit system would require similar transportation improvements. Additionally, modifications to the existing roadway network and traffic operations on Laskin Road, Birdneck Road, and 19th Street would benefit the transit operations and transitions. In order to provide sufficient width for the tracks, the Laskin Road traffic lanes would be moved and reconstructed to have three lanes in each direction (with additional turn lanes). The existing service roads on Laskin Road would be removed.

At the intersection of Laskin Road and Birdneck Road, an additional phase to accommodate the transit vehicles turning from Laskin Road onto Birdneck Road would be added to the signal system. (see **Figure 6-22**)

Figure 6-21| Laskin Road/Birdneck Road Improvements



Source: Fitzgerald & Halliday, Inc., 2014

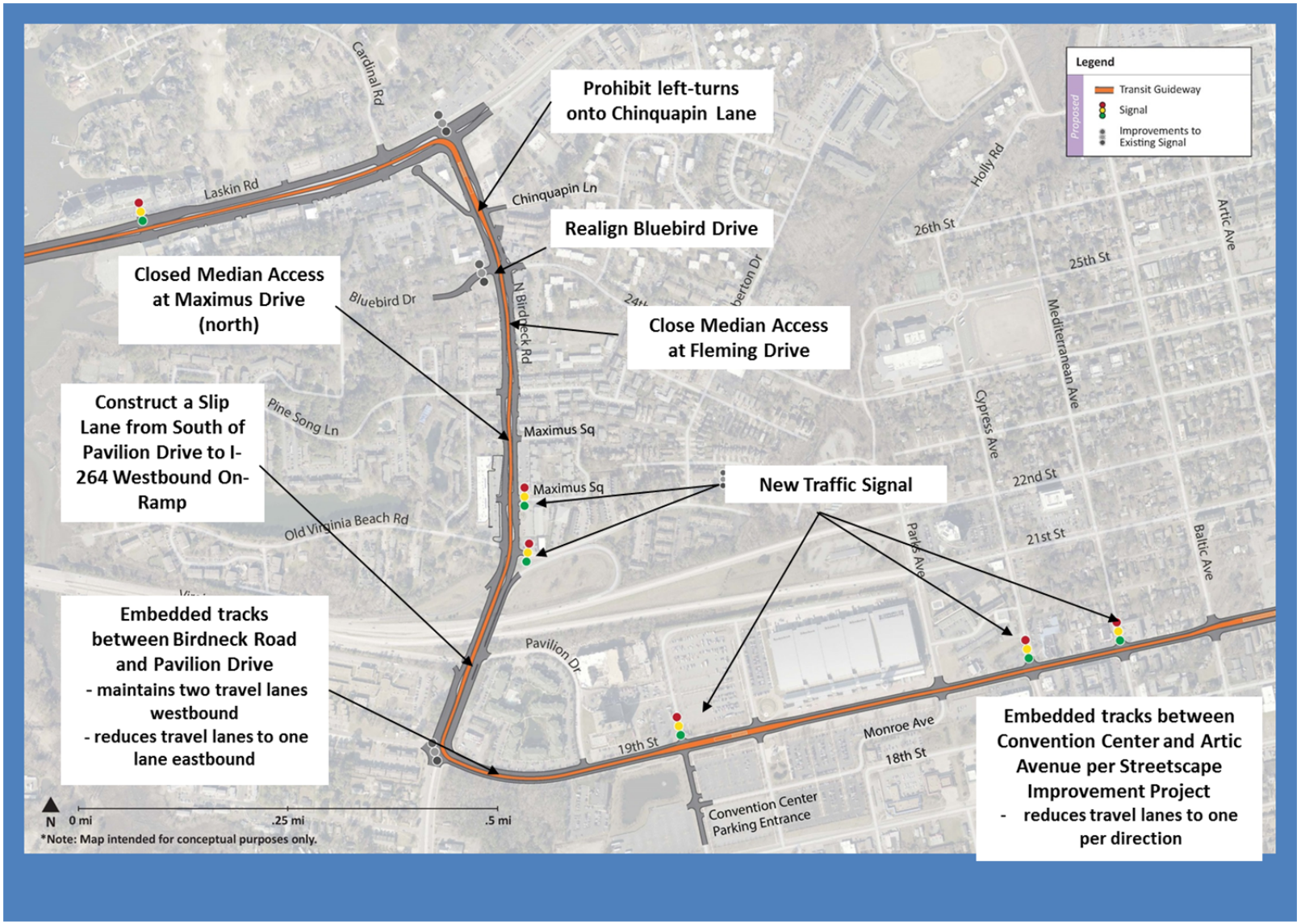
On Birdneck Road, two lanes in each direction would be maintained with the existing turn lanes at signalized intersections. A southbound left turn lane from Birdneck Road onto Chinquapin Lane would be removed to accommodate the Birdneck Station. At the intersection of Birdneck Road with 24th Street, the signal phasing and timing would be modified to accommodate the realignment of Bluebird Drive. South of 24th Street, median access would be closed at Fleming Drive, and the intersection of Birdneck Road with Waterfront Drive/Marabou Lane would remain signalized. Median access at the north driveway of Maximus Square would be closed, and a new signal at the south driveway of Maximus

Square would be installed. To safely accommodate the transit operations, a new signal would be installed at the intersection of Birdneck Road and Old Virginia Beach Road.

Alternative 3 would continue along Birdneck Road under I-264. In the southbound direction, two 11 foot lanes of Birdneck Road would be maintained adjacent to the exclusive guideway. Birdneck Road northbound under I-264 currently consists of two through travel lanes and one dedicated travel lane towards the westbound on-ramp to I-264. Under Alternative 3, two lanes would be provided in each direction on Birdneck Road with the exclusive guideway for the transit system. To maintain a dedicated lane for access to the westbound I-264 on-ramp, a slip lane would be constructed east of the bridge piers. The slip lane would be separate from the through travel lanes. Motorists traveling northbound to I-264 from south of 19th Street would be required to enter the slip lane before reaching Pavilion Drive. (see **Figure 6-23**)

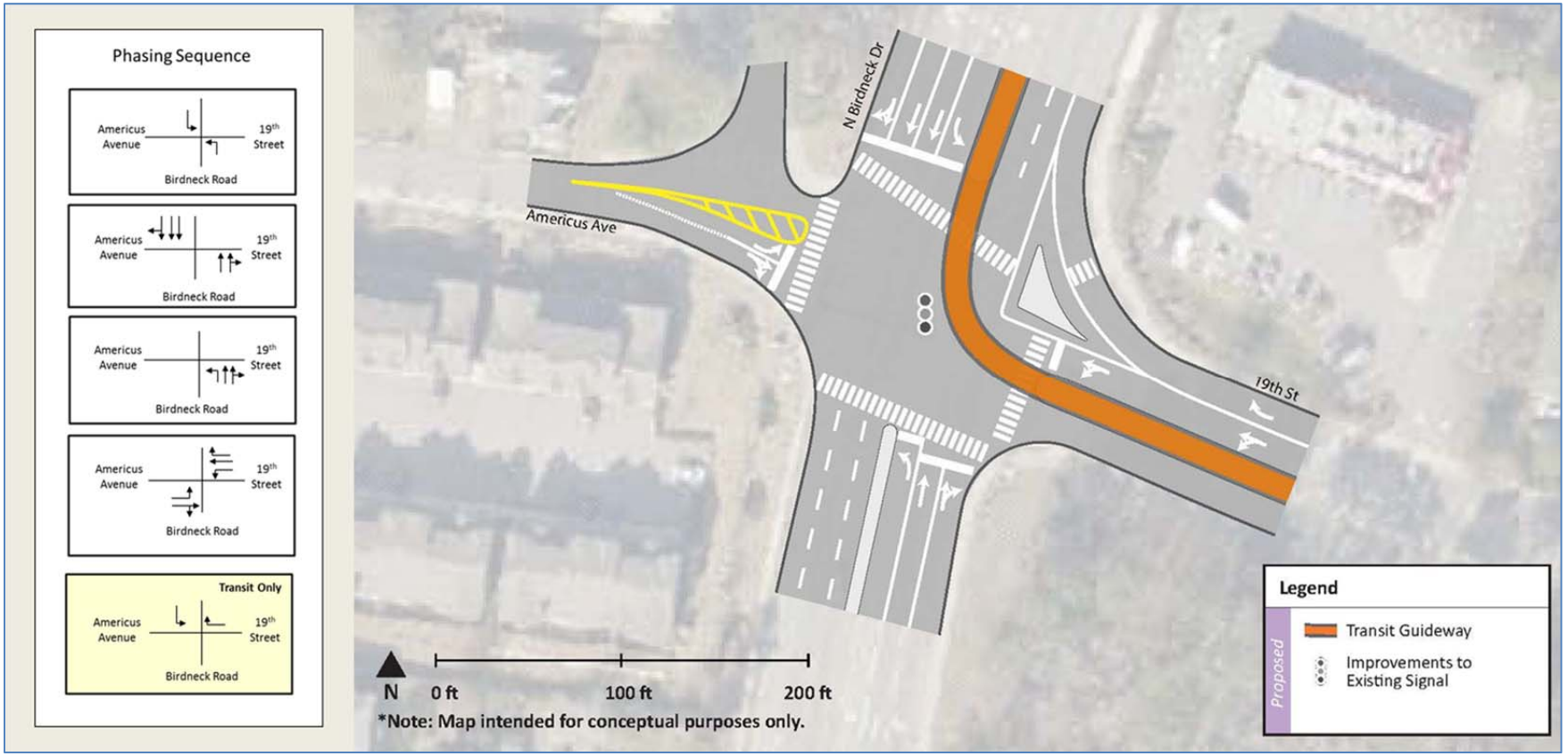
At the intersection of Birdneck Road and 19th Street, an additional phase to accommodate transit vehicles turning from Birdneck Road onto 19th Street would be added to the signal system. (see **Figure 6-24**) On 19th Street, Alternative 3 would provide one vehicular travel lane in each direction between Birdneck Road and Arctic Avenue, a reduction of one travel lane in each direction. New signals at the intersections of 19th Street with the Convention Center parking lot entrance (west of Jefferson Avenue), Cypress Avenue, and Mediterranean Avenue would be installed. (see **Figure 6-23**)

Figure 6-22| Laskin Road to 19th Street Corridor Improvements



Source: Fitzgerald & Halliday, Inc., 2014

Figure 6-23| Birdneck Road/19th Street Improvements



Source: Fitzgerald & Halliday, Inc., 2014

BRT Analysis

Where the BRT build alternative operates in the exclusive guideway, the transit system would require similar transportation improvements and have similar operational characteristics (frequency and speed) as the LRT alternative. As such, the impacts of the BRT Alternative 3 would be the same as the LRT Alternative 1A, 1B, and 2, west of London Bridge Creek.

The BRT would use a new bridge to connect from the NSRR ROW east of London Bridge Creek north to Parker Lane. BRT vehicles would operate in mixed traffic on Parker Lane and Virginia Beach Boulevard through the Laskin Road interchange. BRT vehicles would enter an exclusive guideway that begins at Phillip Avenue. The BRT-exclusive guideway would continue east, in the median of Laskin Road, until it reaches Birdneck Road, including an elevated structure over First Colonial Road. At Birdneck Road, the BRT vehicles would exit the exclusive guideway and turn south on Birdneck Road. BRT would operate in mixed traffic on Birdneck Road and 19th Street until it reaches the terminal station at the Oceanfront Resort Area.

The transit vehicles would not receive any traffic signal priority or other preferential treatment. The BRT vehicles would be expected to adhere to traffic regulations, existing traffic signals and other control devices. As a result, the impacts of the BRT at intersections where it operates in mixed traffic would be similar to the No Build Alternative.

6.5 Construction Impacts

Potential impacts to existing roads that could occur during construction include short-term lane closures, detours, reductions in lane widths, or reduced speeds through work zones. Installation of at-grade crossings and grade separation structures in particular may require extended lane closures or detours to perform the work safely. Installation of bridges and viaducts would require lengthy closures of arterial roadways. A maintenance of traffic plan will be developed during final design to address these impacts and identify strategies for mitigation. Any changes to traffic patterns would be coordinated with the City of Virginia Beach, and public outreach efforts during construction would include announcements regarding construction activities that would affect traffic.

6.6 Indirect Effects

Potential development and redevelopment in the VBTES Corridor and around stations sites could increase localized traffic volumes. These activities, however, would be subject to review and design approval by the City of Virginia Beach; therefore, no adverse indirect impacts to the highway and roadway system are anticipated.

6.7 Avoidance, Minimization, and Mitigation

6.7.1 No Build Alternatives

Under the No Build alternative, the VBTES project would not be undertaken. However, planned transportation improvements by the City of Virginia Beach would occur on Witchduck Road, Laskin Road, and 19th Street. These improvements would occur regardless of the VBTES project. The improvements would improve circulation and access in these areas; therefore, the No Build alternative would not adversely impact the transportation network so no mitigation would be required.

6.7.2 LRT Build Alternatives

The proposed LRT build alternatives traverse through an area that is already congested during peak periods. Transportation improvements such as grade separated crossings, signal installations, signal optimization, and roadway and access modifications as part of the build alternatives would accommodate safe and efficient LRT operations and transitions. LOS D, E, and F operations are already occurring at a number of key intersections along the VBTES Corridor. Typically, these intersections are expected to continue to operate at unacceptable levels of service (LOS D, E or LOS F) in 2034 under the No Build and build alternatives. While the addition of new signals and modifications to signal operations, roadways, and access would increase delay in the corridors to accommodate safe and efficient LRT operations and transitions, traffic congestion and long delays at the intersections are attributed to traffic demand and growth from background development. Traffic signal operations would be refined during later phases of design which may improve the efficiency of traffic flow at intersections to offset delays that may be caused by adding LRT operations.

6.7.3 BRT Build Alternatives

The potential for traffic impacts associated with the BRT Alternatives would be similar to the LRT Alternatives discussed above because it is assumed that a BRT system would operate similar to the LRT. Thus, the mitigation for the BRT Alternatives would be the same as those described for the LRT Alternatives.

7.0 SUPPLEMENTAL ANALYSES

An additional analysis was conducted to analyze a cursory review of specific operations and conditions within the VBTES Corridor. This chapter summarizes the general findings conducted as part of this study to ensure safe and efficient vehicular and pedestrian operations and transit operations of the alternative alignments.

7.1 Laskin Road Corridor Analysis

The HRTPO and VDOT have identified a plan to improve Laskin Road and remove/re-purpose the access roadway network that runs parallel to Laskin Road. This would result in an eight-lane roadway (four travel lanes in each direction) on Laskin Road from 0.2 miles west of First Colonial Road to Winwood Drive and a six-lane roadway (three travel lanes in each direction) from Winwood Drive to 0.3 miles east of Birdneck Road under the No Build Alternative.

For the LRT and BRT Alternative 3, the alignment would be located in the median of Laskin Road. This would require a reduction in travel lanes from eight lanes under the No Build Alternative to six lanes under Alternative 3 between Philip Avenue and Birdneck Road. To assess the operations of the lane reduction between Philip Avenue and Birdneck Road, an arterial analysis was conducted to compare Alternative 3 to the No Build Alternative. Synchro's arterial analysis was used for the purposes of this cursory review assessment and replicates procedures from the HCM 2000 and 2010, Transportation Research Board.

Arterial roadway segment level of service is a function of traffic volume, traffic flow characteristics, roadway cross section, traffic signal spacing and traffic signal timing. For arterial roadway analysis, LOS is defined in terms of the average peak hour travel speed along a segment, including delay and stops. Laskin Road is characterized as Arterial Classification II with a range of free flow speeds 35 to 45 mph. The LOS criteria are shown in **Table 7-1**.

Table 7-1: Arterial Level of Service Criteria

	Description of Condition	Arterial Classification II	
		Level of Service (LOS)	Average Travel Speed (mph)
Delay meets standards	Few delays at intersection	A	>35 mph
	Slight level of delay	B	28-35 mph
	Fair level of delay	C	22-28 mph
	Noticeable delay	D	17-22 mph
Delay exceeds standards	Signal cycles frequently fail	E	13-17 mph
	Over capacity	F	< 13 mph

Source: 2000 Highway Capacity Manual (Special Report 209)
mph: miles per hour

Analysis Results

Results from the analysis, as shown in **Table 7-2,** indicate that the Laskin Road corridor would operate at LOS C during the morning peak hour in both directions as a six lane roadway under Alternative 3, similarly to an eight lane roadway under the No Build Alternative. During the afternoon peak hour, Laskin Road would operate at LOS D under Alternative 3 compared to LOS C during the No Build Alternative in the eastbound direction. Laskin Road would operate similarly in the westbound direction at LOS D under both conditions. The average travel speed would be 21-23 mph, approximately 1 to 2 miles per hour slower than under the No Build Alternative. However, the future traffic demand is anticipated to be supported by the six-lane roadway under the Build alternative with acceptable operations (LOS D or better).

Table 7-2| Laskin Road Operations Summary

	No Build Alternative (8 Lanes)		Alternative 3 (6 Lanes)	
	AM Peak Hour EB/WB	PM Peak Hour EB/WB	AM Peak Hour EB/WB	PM Peak Hour EB/WB
LOS	C/C	C/D	C/C	D/D
Average Travel Speed (mph)	25/23 mph	23/19 mph	23/22 mph	21/21 mph

EB/WB: eastbound/westbound direction of travel
mph: miles per hour

8.0 PARKING

This chapter describes existing and new parking facilities proposed under the Build alternatives. Potential impacts to parking facilities are discussed, including at proposed Park & Ride sites and other locations that would be affected because of construction of the LRT or BRT alternatives.

8.1 Methodology

On-street and off-street parking locations were determined by using aerial photography and conducting field observations. The City of Virginia Beach 2011 Resort Management Annual Report was used to assess the parking inventory owned by the City and the Virginia Beach Development Authority (VBDA) in the Oceanfront Resort Area and at the Town Center of Virginia Beach.

The number of parking spaces required for each station was estimated using the mode of access from the ridership forecast model for the year 2034. Although many passengers would likely drive alone to the transit station, some may share rides with others. To account for this, the estimated number of passengers who drive to each station was divided by a vehicle occupancy factor of 1.12 passengers per vehicle to estimate the parking demand.

Conceptual site plans for each proposed Park & Ride location were developed to maximize the number of parking spaces on the site, while taking into account required site elements such as stormwater management basins, landscaping buffers, pedestrian walkways, and access driveways. The actual number of parking spaces required and provided at each Park & Ride lot will be determined during final design.

8.2 Existing Conditions

Vehicle parking in the VBTES Corridor is provided by both public and private facilities. Private facilities such as surface parking lots, driveways, and garages are found throughout the VBTES Corridor. Public parking facilities include surface lots, garages, on-street parking in designated areas at the Town Center of Virginia Beach and the Oceanfront Resort Area, and on-street parking in other areas.

Private parking in the VBTES Corridor is generally related to a specific land use or development. Outside of the Town Center of Virginia Beach and the Oceanfront Resort Area, individual shopping centers, businesses, and residential complexes provide sufficient parking for their use in accordance with the City's zoning requirements. Field observations found no areas in the VBTES Corridor, except the Oceanfront Resort Area, where parking demand exceeds supply on a sustained basis.

Town Center Public Parking Summary

The Town Center of Virginia Beach is served by approximately 4,550 public parking spaces. There are approximately a total of 4,280 spaces in four parking garages, 321 spaces in a surface lot, and 86 two-hour on-street spaces. ADA accessible parking spaces are found in the parking structures and surface lot. Public parking at Town Center is currently free, but the City charges a fee for reserved spaces in the parking garages. **Table 8-1** summarizes the City-owned parking facilities within a one-half mile walking

distance of the proposed Town Center Station, and **Figure 8-1** shows the location of the parking facilities (the table and figure apply to all four location options under consideration).

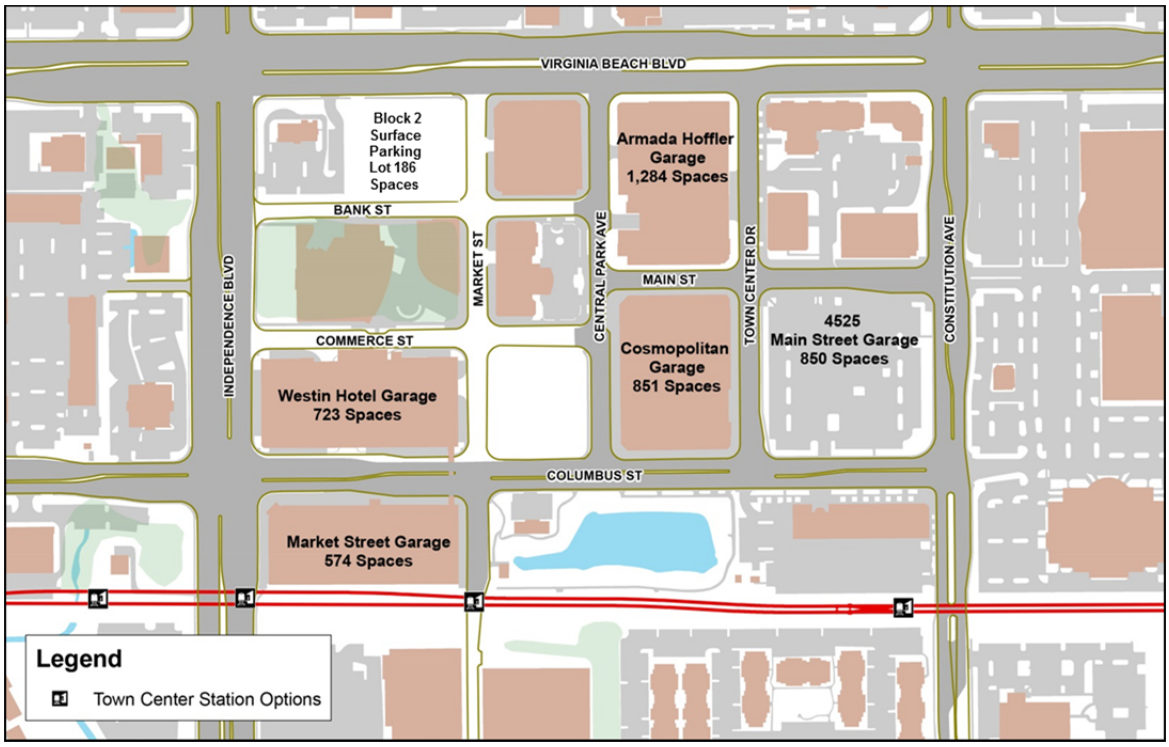
Table 8-1| City-owned Parking within ½ Mile of the Town Center Station

Facility	Spaces
On-Street Parking	86
Block 2 Surface Lot	186
Armada Hoffler Tower Garage	1,284
Westin Hotel Garage	723
Cosmopolitan Garage	851
Market Street Garage	574
4525 Main Street Garage	934
Block 9 Surface Lot	135

Source: 2011 Resort Management Annual Report, City of Virginia Beach

Note: An additional parking structure proposed to have 875 spaces is currently under construction (February, 2014)

Figure 8-1| Locations of City-Owned Parking within 1/2 mile of Proposed Town Center Station



Source: vbgov.com, City of Virginia Beach, 2014

Oceanfront Public Parking Summary

The City of Virginia Beach operates two parking garages, nine surface parking lots, a residential parking permit program, and metered parking spaces in the Oceanfront Resort Area, totaling approximately 2,900 off-street parking spaces and 4,700 on-street parking spaces (647 spaces are metered). A new parking garage is under construction to replace the surface lot at 25th Street, which will support adjacent development as well as provide public parking for the area. High seasonal turnover rates are associated with most of the Oceanfront Resort Area parking as a result of increased tourism activity, particularly during the summer months. Metered parking promotes higher turnover over shorter periods of time, and it is enforced seven days a week, 24 hours a day, from April 1 through October 31. Unmetered parking in the Oceanfront Resort Area is managed by the Residential Permit Parking Program. Parking lots and garages owned by the City charge daily or hourly fees, depending on location.

Table 8-2 summarizes the existing off-street parking facilities owned by the City within a one-half mile walking distance of the proposed Oceanfront Station, which is located at the corner of 19th Street and Arctic Avenue. The two lots located on 19th Street contain 538 parking spaces. An additional 377 spaces will become available in the new City-owned garage at 25th Street that is scheduled to open in 2015. **Figure 8-2** shows the location of these parking facilities.

Table 8-2| City-owned Parking within ½ Mile of the Oceanfront Station

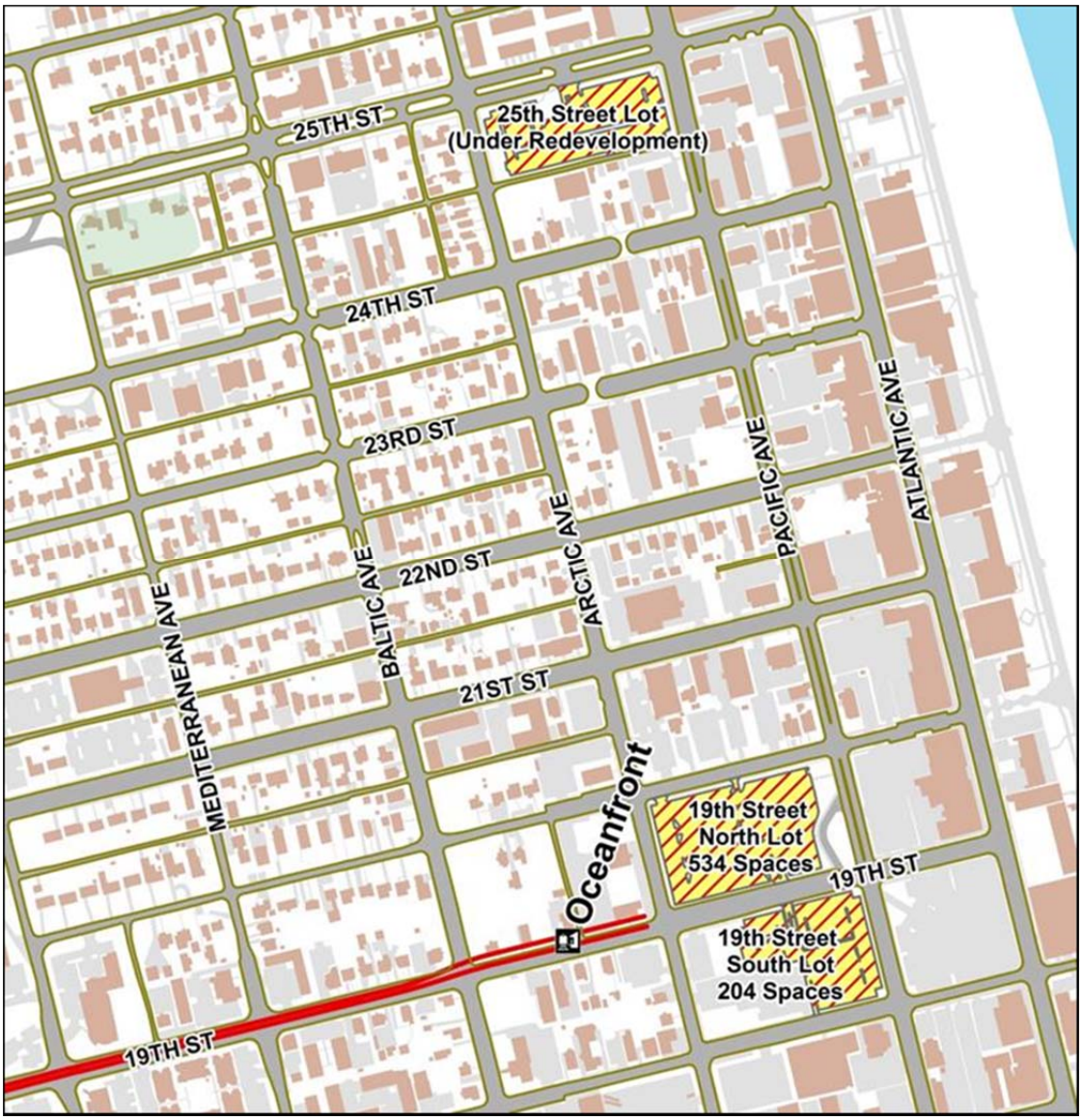
Facility	Spaces
19th Street North Lot	334
19th Street South Lot	204

Source: vbgov.com, City of Virginia Beach, 2014

Note: The two 19th Street Lots are currently being considered for redevelopment, although no plans have been finalized

The 25th Street Lot is currently being redeveloped. The site plan calls for 377 public parking spaces in a new structure that the City will own and operate, in addition to 221 spaces that will be leased by the developer for use by residents of an adjacent apartment building.

Figure 8-2| Locations of City-Owned Parking within 1/2 mile of Proposed Oceanfront Station



Source: vbgov.com, City of Virginia Beach, 2014

8.3 No Build Alternative

Under the No Build alternative, none of the build alternatives would be constructed; thus, there would be no project-related impacts to parking in the VBTES Corridor. Future changes in land use and site development not related to the proposed project would still occur with resulting changes to available public and private parking. Projects planned by the City of Virginia Beach would also occur, such as improvements to 19th Street and construction of new parking facilities in the Oceanfront Resort Area. Any such future changes to land use and/or site development would be in accordance with the City of Virginia Beach's zoning and building codes, which include requirements for adequate parking.

8.4 LRT Build Alternative

The build alternatives have the potential to both increase and decrease the parking supply in the VBTES Corridor. Parking supply losses could occur through the conversion of private parking areas to station sites and other transportation uses, and parking supply increases could occur at new Park & Ride lots.

The following sections summarize the various physical parking characteristics associated with each alternative.

8.4.1 Alternative 1A: Town Center Alternative

Under Alternative 1A, a Park & Ride lot would be provided for each of the proposed stations (Witchduck and Town Center). Conceptual plans show that approximately 480 parking spaces would be provided, as shown in **Table 8-3**.

Table 8-3| LRT Parking Summary for Alternative 1A

Station	Existing (Current) Parking Spaces on Site[1]	Projected Station Parking Demand in 2034[2]	New Station Parking Proposed[3]	Proposed Parking Use
Witchduck	40	217	250	Transit only
Town Center (all station options)	209	253	230	Transit only
Alternative 1A Totals	**249**	**470**	**480**	

[1]*Approximate spaces based off aerials and field observations.*

[2]*Required spaces based on 2034 ridership forecast.*

[3]*Proposed number of spaces is approximate and may change during final design.*

Source: Fitzgerald & Halliday, Inc., 2014

Parking for the proposed Witchduck Station would be developed in coordination with the City's planned Housing Resource Center at the intersection of Southern Boulevard and Jersey Avenue. Access to the proposed lot would be provided off Southern Boulevard and Jersey Avenue. The proposed Park & Ride site is a vacant former commercial building and warehouse that is currently owned by the City of Virginia Beach. There are approximately 40 parking spaces on the site adjacent to the now-vacant commercial building and a large paved area surrounding the warehouse that may have also been used for parking. To accommodate the Park & Ride lot, this area would be reconstructed and the existing buildings removed. The proposed Park & Ride lot could provide as many as 250 spaces. The projected parking demand for transit use under Alternative 1A is 217 spaces. There may be opportunities to have a joint-use parking facility with the planned Virginia Beach Housing Resource Center, but parking requirements for that development have not been identified at this time.

Although there are four options for the Town Center Station location, all of them would be served by a Park & Ride lot located at the northeast corner of Independence Boulevard and Garrett Drive, south of the former NSRR ROW. Access to the proposed Park & Ride lot would be provided from Garrett Drive. A parking lot that provides approximately 209 spaces and a commercial building owned by the City currently exist on the site. The existing parking area would be reconstructed and the building removed to accommodate the Park & Ride lot. The proposed Park & Ride lot could provide as many as 230 spaces, approximately 23 fewer spaces than the projected demand. However, the 480 proposed parking spaces within the VBTES Corridor at the Witchduck and Town Center stations combined remains greater than the projected demand of 470 spaces, as shown in **Table 8-3**. Patrons who encounter a full Park & Ride lot at one station could choose to drive to another nearby station that would likely have available parking, or they could use another mode of travel. Additional study regarding these behaviors and design of Park & Ride facilities to identify the exact number of spaces will take place during later phases of design.

8.4.2 Alternative 1B: Rosemont Alternative

Under Alternative 1B, a Park & Ride lot would be provided for each of the three proposed stations (Witchduck, Town Center, and Rosemont). Conceptual plans show that approximately 655 parking spaces would be provided, as shown in **Table 8-4**.

Table 8-4| LRT Parking Summary for Alternative 1B

Station	Existing (Current) Parking Spaces on Site[1]	Projected Station Parking Demand in 2034[2]	New Station Parking Proposed[3]	Proposed Parking Use
Witchduck	40	113	250	Transit only
Town Center (all station options)	209	155	230	Transit only
Rosemont	0	285	175	Transit only
Alternative 1B Totals	**249**	**553**	**655**	

[1]Approximate spaces based off aerials and field observations.
[2]Required spaces based on 2034 ridership forecast.
[3]Number of spaces is approximate and may change during final design.
Source: Fitzgerald & Halliday, Inc., 2014

Between The Tide's Newtown Road Station and the proposed Town Center Station, Alternative 1B would have the same stations and Park & Ride lots as those identified for Alternative 1A. The projected parking demand at the Witchduck and Town Center Park & Ride lots is lower in Alternative 1B due to changes in ridership and the proportion of riders who are forecasted to be driving to those stations compared to Alternative 1A, which ends at Town Center. At the Rosemont Station, parking is proposed at the southeast corner of Virginia Beach Boulevard and Lynn Shores Drive. The site is undeveloped except for three billboard structures that would be removed. The proposed Park & Ride lot could provide as many as 175 spaces based on the available space on the site. This lot would not accommodate the unconstrained forecasted demand of 285 spaces that is projected for Alternative 1B. Additional study would be required in future stages of project development to determine the effects of spillover parking or changes in ridership patterns because of the lack of adequate parking. As indicated in **Table 8-4**, the proposed 655 parking spaces for the three stations in Alternative 1B combined is approximately 100 greater than the projected demand of 553. Potential riders would have the opportunity to use Park & Ride lots at other stations or choose another mode of transportation to reach their destination if their first station choice does not have parking available when they arrive.

8.4.3 Alternative 2: NSRR Alternative

Between The Tide's Newtown Road Station and the proposed Rosemont Station, Alternative 2 would have the same stations and Park & Ride lots as those identified for Alternative 1B. However, because this alternative includes stations and Park & Ride lots east of Rosemont, the forecast parking demand at

the Rosemont Station is reduced to 177 spaces, which is near the capacity of the lot developed for the conceptual design.

Alternative 2 would provide two additional Park & Ride lots: one at the Lynnhaven Station and the other at the North Oceana Station. Alternative 2 would also make use of existing public parking at the Convention Center and Oceanfront Stations. Approximately 1,105 new parking spaces could be provided based on conceptual designs to accommodate a demand of 785 spaces, as shown in **Table 8-5**.

Table 8-5| LRT Parking Summary for Alternative 2

Station	Existing (Current) Parking Spaces on Site[1]	Projected Station Parking Demand in 2034[2]	New Station Parking Proposed[3]	Proposed Parking Use
Witchduck	40	112	250	Transit only
Town Center (all options)	209	155	230	Transit only
Rosemont	0	177	175	Transit only
Lynnhaven	180	163	175	Transit only
North Oceana	0	47	275	Transit only
Convention Center	*	124	0	Transit and Convention Center
Oceanfront[4]	0	7	0	City public facilities
Alternative 2 Totals	**429**	**785**	**1,105 + shared**	

**The Convention Center currently has approximately 2,209 parking spaces in adjacent lots. The station would share parking with the Convention Center.*

[1]Approximate spaces based off aerials and field observations.

[2]Required spaces based on 2034 ridership forecast.

[3]Number of spaces is approximate and may change during final design.

[4]"Walk-Up" station, no parking provided

Source: Fitzgerald & Halliday, Inc., 2014

The Lynnhaven Station would provide parking at the northeast corner of Lynnhaven Road and Southern Boulevard. This area is currently occupied by a small office building with 35 parking spaces and an adjacent 145 space paved parking lot that is used by a nearby auto dealership for vehicle storage. The combined existing parking total is approximately 180 private spaces. The building and the existing parking lots would be removed to develop the Lynnhaven Station Park & Ride. The proposed lot could

provide as many as 175 spaces, with an estimated transit parking demand of 163 spaces. A traction power substation for the LRT is also proposed at this location. Access to the proposed lot would be provided via driveways off Southern Boulevard.

The North Oceana Station would have parking on a city-owned parcel north of Potters Road that is currently used for construction material disposal and temporary storm debris storage. The Park & Ride lot would have a new access drive constructed from Potters Road with an at-grade crossing of the LRT tracks. The proposed lot could provide as many as 275 new spaces; the projected parking demand is 47 spaces.

The Convention Center Station would not have a new dedicated parking facility. Instead, it is anticipated that existing Convention Center parking lots adjacent to the station would be available for Park & Ride users. The Convention Center parking lots currently include 2,209 public parking spaces. Based on projected ridership at the Convention Center Station, 124 of these spaces would be required for transit use in the forecast year.

On-street parking is currently allowed on the north side of 19th Street between Baltic Avenue and Arctic Avenue. There are four marked on-street spaces on the north side of the street near Arctic Avenue. The westbound right lane of 19th Street is available for parking, but it is a travel lane when not used for that purpose. All of the on-street parking on 19th Street would be eliminated as part of a City of Virginia Beach plan to make improvements between Parks Avenue and Arctic Avenue. The LRT tracks and Oceanfront Station would be coordinated with the planned improvements.

The Oceanfront Station would be a walk-up station, with no parking specifically designated for transit use. The projected parking demand under Alternative 2 is 7 spaces. A new City-owned parking garage is planned for the property immediately north of the proposed station, which will provide approximately 800 spaces. Transit riders who wish to drive to the Oceanfront Station may use public parking in the area, including the new City-owned parking garage, subject to availability and prevailing parking rates.

8.4.4 Alternative 3: Hilltop Alternative

Between The Tide's Newtown Road Station and the proposed Lynnhaven Station, Alternative 3 would have the same stations and Park & Ride lots identified for Alternative 2. The North Oceana Station and associated Park & Ride lot provided under Alternative 2 would not be constructed as part of Alternative 3, but three additional Park & Ride lots would be provided at the Great Neck, Hilltop East, and Birdneck Stations. Alternative 3's Hilltop West Station would be a walk-up station, without public parking. Parking for the Convention Center and Oceanfront stations would be as described for Alternative 2. The parking demand at each station differs between Alternatives 2 and 3 because of changes in ridership patterns; **Table 8-6** shows the number of proposed spaces at each station and the forecasted demand. For Alternative 3, a total of 1,480 new parking spaces could be provided with a projected parking demand of 914 spaces.

Table 8-6| LRT Parking Summary for Alternative 3

Station	Existing (Current) Parking Spaces on Site[1]	Projected Station Parking Demand in 2034[2]	New Station Parking Proposed[3]	Proposed Parking Use
Witchduck	40	119	250	Transit only
Town Center (all options)	209	152	230	Transit only
Rosemont	0	169	175	Transit only
Lynnhaven	180	145	175	Transit only
Greatneck	420	56	250	Transit only
Hilltop West4	0	68	0	Shopping Centers / businesses
Hilltop East	0	45	250	Transit only
Birdneck	130	83	150	Transit only
Convention Center	0	77	0	Transit and Convention Center
Oceanfront[4]	0	0	0	City public facilities
Alternative 3 Totals	**979**	**914**	**1,480 + shared**	

**The Convention Center currently has approximately 2,209 parking spaces in adjacent lots. The station would share parking with the Convention Center.*

[1]Approximate spaces based off aerials and field observations.

[2]Required spaces based on 2034 ridership forecast.

[3]Number of spaces is approximate and may change during final design.

[4]"Walk-Up" station, no parking provided

Source: Fitzgerald & Halliday, Inc., 2014

Parking would be provided for the Great Neck Station at the southwest corner of Virginia Beach Boulevard and Great Neck Road. The proposed site currently consists of commercial buildings and paved areas for parking and storage, and it includes approximately 420 private spaces. The existing paved

areas would be reconstructed and buildings removed to accommodate the station design. Approximately 250 spaces could be provided for a projected parking demand of 56 spaces. Vehicular access would be provided to the station via Virginia Beach Boulevard and Byrd Lane.

The Hilltop West Station would be a walk-up station, with no designated parking available for use by transit patrons. However, the ridership model predicts a parking demand of 68 spaces for this station.

For the Hilltop East Station, parking would be provided on the site of the Virginia Beach City Public Schools' Laskin Road Annex, at the southeast corner of Laskin Road and Winwood Drive. This site is approximately 650 feet east of the station platform and would be linked to the station with a paved sidewalk. As many as 250 spaces could be provided on the proposed site, with a projected parking demand of 45 spaces.

At the Birdneck Station, a Park & Ride lot is proposed for the southeast corner of the Laskin Road/Birdneck Road intersection. The proposed site consists of two adjoining parcels. One parcel is a vacant lot that was previously the site of a gas station, and the other is a vacant former restaurant building with a paved parking lot with approximately 130 spaces. Approximately 150 spaces could be provided on the site, which would be accessed from Laskin Road. The forecasted demand for parking at this site is approximately 83 spaces.

Roadway widening on Birdneck Road to accommodate the LRT guideway and turn lanes would affect parking on private property adjacent to the roadway (see **Figure 8-3**). Part of the parking lot for an apartment building on the southeast corner of Birdneck Road and Chinquapin Lane would be affected by widening Birdneck Road south of the Birdneck Station; one space in that parking lot would be removed. Widening of Birdneck Road to accommodate the LRT guideway and turn lanes at the 24th Street intersection will affect parking spaces that serve the property on the southeast corner; however, reconfiguring the parking lot on the property would result in no net loss of spaces. The parking lot for the Birdneck Shoppes shopping center on the west side of Birdneck Road would be reconfigured to accommodate the guideway and left turn lanes at a new signalized intersection serving that shopping center and the south entrance of the Sea Pines Apartments (Maximus Square). This would require removing approximately 17 parking spaces. As a result, there would be a net loss of 18 spaces for all private properties along Birdneck Road.

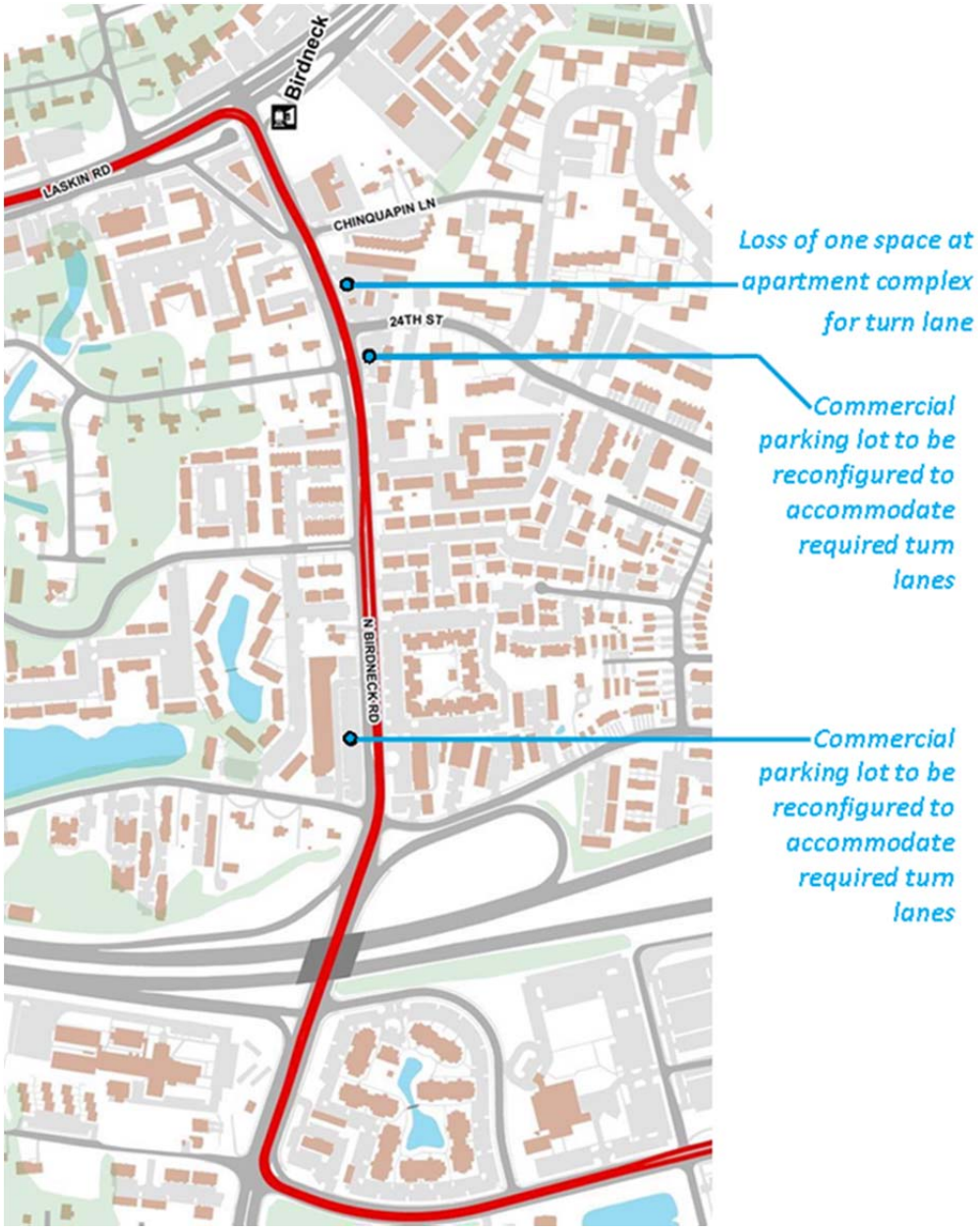
Parking for the Convention Center Station in Alternative 3 would use existing Convention Center parking lots as previously described for Alternative 2. Under Alternative 3, a parking demand of 77 spaces is projected for transit use at this station.

The City's planned improvements on 19th Street are expected to be constructed for Alternative 3 in the same manner as Alternative 2. The existing on-street parking on 19th Street between Baltic Avenue and Arctic Avenue would also be removed under Alternative 3.

The Oceanfront Station would be the same as with Alternative 2. However, unlike Alternative 2, the ridership model predicts no transit parking demand at the Oceanfront Station for Alternative 3. The 2034 ridership model projects that transit users have a different arrival preference at this station based

on the alignment route for Alternative 3, and all of the passengers boarding would be from walk-ups or transfers. In addition, the City is building an approximately 800 space public parking garage north of the station. Both the new garage and other existing public parking facilities in the Oceanfront Resort Area would be available to transit users.

Figure 8-3| Birdneck Road Proposed Parking Changes (Alternative 3)



Source: HDR Engineering, 2014

8.5 BRT Build Alternative

The BRT Build alternatives include the same station and Park & Ride facility locations as the corresponding LRT Alternatives. The parking demand varies between the BRT and LRT alternatives because of differences in forecast ridership. Impacts to private parking will differ due to BRT operations in mixed traffic at the eastern end of the alignments. These impacts are described in the following sections.

8.5.1 Alternative 1A: Town Center Alternative

The BRT Alternative 1A stations at Witchduck and Town Center would be in the same locations as the LRT stations. The lower ridership forecasted for the BRT alternative reduces the parking demand at these stations. **Table 8-7** lists the existing number of spaces at each site, projected demand, and proposed number of spaces based on the conceptual station area designs.

Table 8-7| BRT Parking Summary for Alternative 1A

Station	Existing (Current) Parking Spaces on Site[1]	Projected Station Parking Demand in 2034[2]	New Station Parking Proposed[3]	Proposed Parking Use
Witchduck	40	101	250	Transit only
Town Center (all station options)	209	217	230	Transit only
Alternative 1A Totals	**249**	**318**	**480**	

[1]Approximate spaces based off aerials and field observations.
[2]Required spaces based on 2034 ridership forecast.
[3]Number of spaces is approximate and may change during final design.
Source: Fitzgerald & Halliday, Inc., 2014

8.5.2 Alternative 1B: Rosemont Alternative

The BRT Alternative 1B stations at Witchduck, Town Center, and Rosemont would be in the same locations as the LRT stations. The lower ridership forecasted for the BRT alternative reduces the parking demand at these stations **Table 8-8** lists the existing number of spaces at each site, projected demand, and proposed number of spaces based on the conceptual station area designs.

Table 8-8| BRT Parking Summary for Alternative 1B

Station	Existing (Current) Parking Spaces on Site[1]	Projected Station Parking Demand in 2034[2]	New Station Parking Proposed[3]	Proposed Parking Use
Witchduck	40	66	250	Transit only
Town Center (all station options)	209	91	230	Transit only
Rosemont	0	168	175	Transit only
Alternative 1B Totals	**249**	**325**	**655**	

[1]Approximate spaces based off aerials and field observations.
[2]Required spaces based on 2034 ridership forecast.
[3]Number of spaces is approximate and may change during final design.
Source: Fitzgerald & Halliday, Inc., 2014

8.5.3 Alternative 2: NSRR Alternative

For the BRT Alternative 2, stations would be placed in the same locations as the LRT Alternative 2. Park & Ride lots would be placed near all of the stations on the former NSRR ROW, while the Convention Center Station would share the existing Convention Center parking areas, and the Oceanfront Station would continue not to have designated parking specifically for transit use. A summary of the parking at BRT stations under Alternative 2, including changes in demand because of forecasted ridership, can be found in **Table 8-9**.

Table 8-9| BRT Parking Summary for Alternative 2

Station	Existing (Current) Parking Spaces on Site[1]	Projected Station Parking Demand in 2034[2]	New Station Parking Proposed[3]	Proposed Parking Use
Witchduck	40	72	250	Transit only
Town Center (all options)	209	98	230	Transit only
Rosemont	0	113	175	Transit only
Lynnhaven	180	104	175	Transit only
North Oceana	0	28	275	Transit only
Convention Center	*	77	0	Transit and Convention Center
Oceanfront[4]	0	4	0	City public facilities
Alternative 2 Totals	**429**	**496**	**1,105 + shared**	

**The Convention Center currently has approximately 2,209 parking spaces in adjacent lots. The station would share parking with the Convention Center.*

[1]Approximate spaces based off aerials and field observations.

[2]Required spaces based on 2034 ridership forecast.

[3]Number of spaces is approximate and may change during final design.

[4]"Walk-Up" station, no parking provided

Source: Fitzgerald & Halliday, Inc., 2014

8.5.4 Alternative 3: Hilltop Alternative

Similar to the other alternatives, the BRT Alternative 3 would serve stations in the same areas as the LRT Alternative. Park & Ride lots will be located at the stations on the former NSRR ROW and at the Great Neck, Hilltop East, and Birdneck Stations. The Convention Center Station and Oceanfront Station would have the same kind of parking arrangements as the LRT Alternative 3. **Table 8-10** shows a summary of the parking provided and forecasted demand at each BRT station.

Table 8-10| BRT Parking Summary for Alternative 3

Station	Existing (Current) Parking Spaces on Site[1]	Projected Station Parking Demand in 2034[2]	New Station Parking Proposed[3]	Proposed Parking Use
Witchduck	40	77	250	Transit only
Town Center (all options)	209	98	230	Transit only
Rosemont	0	109	175	Transit only
Lynnhaven	180	92	175	Transit only
Greatneck	420	36	250	Transit only
Hilltop West4	0	44	0	Shopping Centers / businesses
Hilltop East	0	29	250	Transit only
Birdneck	130	54	150	Transit only
Convention Center	*	41	0	Transit and Convention Center
Oceanfront4	0	0	0	City public facilities
Alternative 3 Totals	**979**	**580**	**1,480 + shared**	

**The Convention Center currently has approximately 2,209 parking spaces in adjacent lots. The station would share parking with the Convention Center.*

[1]Approximate spaces based off aerials and field observations.

[2]Required spaces based on 2034 ridership forecast.

[3]Number of spaces is approximate and may change during final design.

[4]"Walk-Up" station, no parking provided

Source: Fitzgerald & Halliday, Inc., 2014

On Birdneck Road, the BRT Alternative 3 would run in mixed traffic within the existing roadway. Because no roadway widening is anticipated, there would be no impacts to parking on private property except for the Birdneck Station Park & Ride.

8.6 Construction Impacts

Existing public or private parking facilities may be affected during the construction of any of the LRT or BRT build alternatives. Construction activities that would occur adjacent to parking lots may require temporary easements to provide additional space to install the LRT tracks, BRT guideway, other system elements, sidewalks, or roadway improvements associated with construction of the transit system. The locations of parking areas affected during construction will be identified during final design. In most cases, the affected parking would be limited to the area immediately adjacent to construction, and most parking lots have a surplus of parking spaces that can absorb a short-term loss of use of a small portion of the lot. These impacts are temporary in nature, and the parking areas would be restored to their owners upon completion of the work. A construction management plan would be developed during final design to identify the impacts of construction activities and potential mitigation strategies.

8.7 Indirect Effects

The traffic analysis, as identified in the Roadway and Traffic section, included area traffic projections to account for average daily demand. While an increase in parking supply and improvements to station access would increase traffic demand, particularly at VBTES Corridor area intersections near the stations, traffic congestion and long delays at the intersections are attributed primarily to growth from background development. Thus, no adverse impacts to local roadways or traffic from the new parking arrangements are anticipated.

Development and redevelopment activities around the study area intersections and stations could increase the demand for public and private parking. These activities, however, would be subject to the City of Virginia Beach planning review and zoning code requirements. The level of impacts would depend on the details of the future development and implementation of City requirements regarding the size of parking facilities and methods of access to serve those properties.

8.8 Avoidance, Minimization, and Mitigation

8.8.1 No Build Alternatives

Under the No Build Alternative, the VBTES project would not be undertaken. No changes to parking would occur so no mitigation would be required.

8.8.2 Build Alternatives

The parking facilities considered for the LRT and BRT build alternatives are intended to improve accessibility to the transit stations, minimize impacts to automobile traffic, and increase pedestrian and vehicle safety. Parking facilities in most locations within the City would not be adversely affected by any of the build alternatives. The combined number of spaces at all proposed Park & Ride lots under each alternative would meet the total demand projected to be generated by patrons who would park at a

station and ride the transit system, so it would be likely that other stations would have parking available in the event that one particular facility may be full.

At Town Center (Alternative 1A), Rosemont (Alternatives 1B, 2, and 3) and Hilltop West (Alternative 3) Stations, where parking demand may exceed proposed supply, HRT and the City would initiate a dialogue for shared parking arrangements with nearby property owners with potentially available parking space. Additionally, the effect of diverting drivers to other stations will be examined in future updates of the ridership forecasts.

An agreement for use of the Convention Center lots would be made between HRT and the City of Virginia Beach to allow shared use of the existing lots by transit patrons. If necessary, restrictions can be placed on transit parking in these lots when there is an event at the Convention Center that will require its full capacity. However, it is anticipated that event participants using the transit system instead of driving would likely offset any transit parking demand during events.

The loss of on-street parking on 19th Street as part of the City's planned improvement project would be offset by the City's planned parking garage north of 19th Street, which would further increase the parking supply in the Oceanfront Resort Area. Thus, there is minimal overall effect to available parking from the build alternatives.

Generally, where existing private parking facilities would be removed, the commercial or retail establishment that the parking served would also be displaced. Although a small number of commercial parking spaces would be lost along Birdneck Road, it is anticipated that parking at the Birdneck Station would be available for shared parking on most days. The Birdneck Station is within a one-third mile walking distance of the affected properties, thereby potentially reducing demand for parking at those locations due to potential mode shift to transit. Additional coordination will be required between HRT, the City, and the affected property owners.